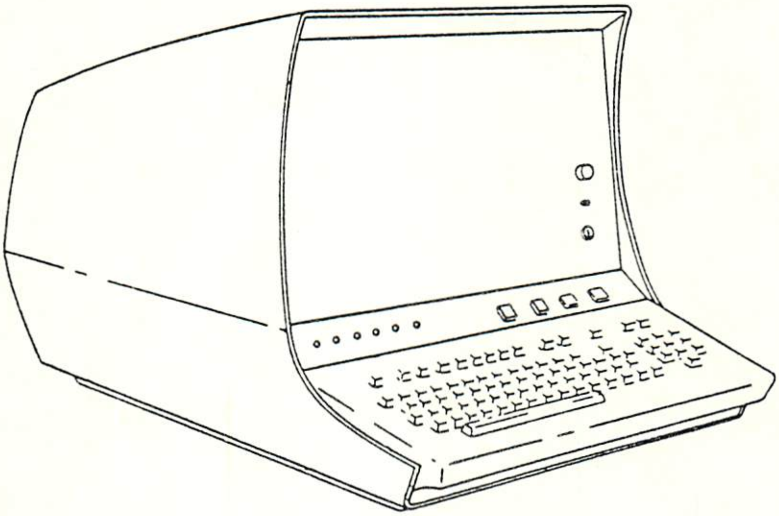
CONTROL DATA® 92423-10

DISPLAY TERMINAL

CC5A5-A, CC5A6-A



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REFERENCE MANUAL

92423-10
DISPLAY TERMINAL REFERENCE MANUAL

SECTIONS IN THIS MANUAL:

Section 1 — General Description

Section 2 — Operation

Section 3 — Programming

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Reference Manual

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A

FOREWORD

This Reference Manual applies to the 92423-10 Display Terminal. This terminal is the 120-volt, 60-Hz unit defined as equipment CC5A5-A or it is the 208/230-volt, 50-Hz unit defined as equipment CC5A6-A and may include the expanded memory modification kit defined as optional equipment BT1A9-A. The terminal is designed to share an optional 92427 Receive-Only Nonimpact Printer in conjunction with up to seven other Display Terminals.

This manual contains three sections. Section 1 defines the functions and specifications. Section 2 explains the controls available to the operator and describes basic operating procedures. Section 3 contains information pertaining to programming including receive data and transmit data message formats, communications word format and codes, and communications modes.

Operating and programming information for the optional printer is contained in the manual listed below. Copies of the manual covering the printer or additional copies of this manual may be ordered from:

Control Data Corporation
Literature and Distribution Services
8100 34th Avenue South, P.O. Box 0
Minneapolis, Minnesota 55440

Manual Title	Publication No.
92427 Nonimpact Printer Station Reference Manual	62122800

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GENERAL DESCRIPTION

1

The Display Terminal (figure 1-1) is configured to operate as a video display, telecommunication, remote terminal capable of transmitting and receiving messages on either leased or dial telephone lines. The terminal is composed basically of a CRT display, and an alphanumeric keyboard housed in a single cabinet. It is designed for telecommunications either under program control of a central processor, or on a direct line to standard telecommunication stations. The terminal provides an operator with composition versatility not possible with conventional teletypewriter terminals and operates quickly and relatively noise-free as compared to a teletypewriter terminal.

The Display Terminal is expressly designed for telecommunications system and program compatibility and is ready for immediate use at any terminal location which provides an asynchronous EIA Standard RS-232-C modem (modulator/demodulator) equivalent to the AT&T 103 series modem. This interface is compatible with CCITT recommendation V.24 interface. Telecommunications with the terminal are performed via the modem either in a bit-serial character-by-character fashion, or by bit-serial block message transfers. The terminal operator may select either mode for message transmission (character-by-character or block) via transmission mode controls included in the terminal. The asynchronous terminal interface will receive or transmit data at 75, 110, 150, 200, 300, 600, 1200, 1800, 2400, 4800, or 9600 baud.

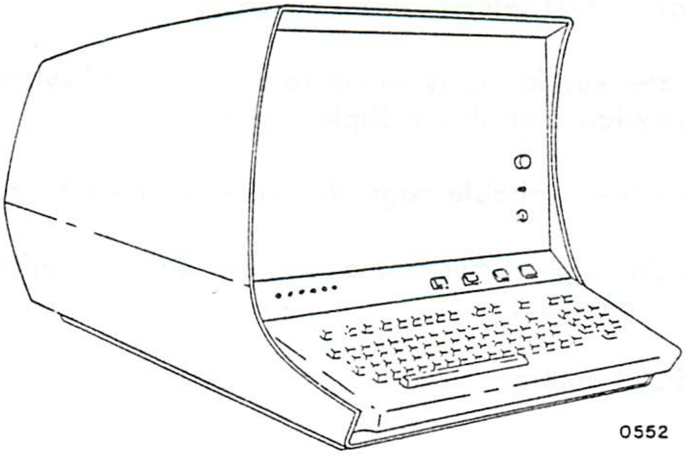


Figure 1-1. Display Terminal

The terminal is designed to share an optional hardcopy, serial interface, printer in conjunction with up to seven other Display Terminals. Figure 1-2 shows a typical terminal communications system.

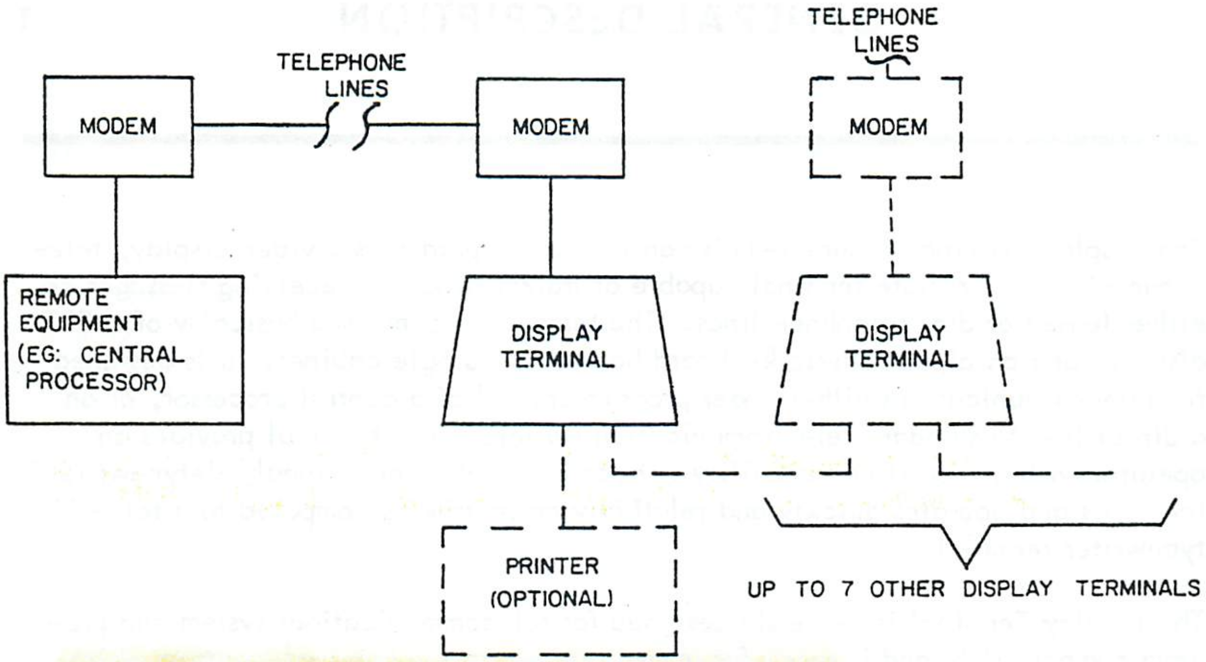


Figure 1-2. Typical Terminal Communications System

FEATURES

A summary of Display Terminal features follows.

- Keyboard layout has simplified tri-level arrangement instead of the typical 4-level teletypewriter keyboard.
- Character key layout is similar to a typewriter keyboard. Additional keys provide controls for display operation.
- Clatter-free, reliable magnetic-reed-switch keyboard.
- 96 ASCII* alphanumerics and symbols, with the option of 64 characters or 96 characters.
- 32 ASCII* control codes.

---

* American National Standard Code for Information Interchange; ANSI X3.4-1968.

- Scroll or page format (switch selectable).
- Blinking cursor (dash underline) highlighting the data entry point.
- Cursor control for up, down, left, right, and reset.
- Normal display of white characters on a black background.
- Inverse video display field with black characters on a white background; as many fields of any length may be used as needed.
- Display viewing area approximately 9-1/4 inches (23.5 cm) wide by 5-1/4 inches (13 cm) high.
- Nominal character size 3/16 inch (0.5 cm) high by 3/32 inch (0.3 cm) wide formed by a 9 x 5 dot matrix using standard television raster scan.
- Eight lines of 80 characters in the basic machine with add-on capability (see Optional Features).
- 60/50-Hz display refresh rate.
- Adjustable display brightness.
- Metal oxide semi-conductor memory (MOS).
- RS-232-C interface (CCITT recommendation V.24 compatible) capable of asynchronous data transmission at 75, 110, 150, 200, 300, 600, 1200, 1800, 2400, 4800, 9600 baud.
- Switch selections for: full duplex (transfer data and display of returned data from remote), half duplex (transfer data and display it), odd, even or no parity, block mode (compose and display data for block transfer); keyboard lockout; remote or local; scroll or page format, selectable baud rate; printer on/off line.

  MARK (PARITY)
- Conversational (character-by-character) or block message transfer.
- Output channel for optional hardcopy printer.
- Data source initiated printout capability on printer channel as option.
- Modular construction for quick field repair.

OPTIONAL FEATURES

- Character-memory design allows for expansion with the addition of a 640-character memory card which may be field installed. Display format becomes 16 lines of 80 characters each.
- Hardcopy receive-only printer.

16 x 80 DISPLAY FORMAT OPTION

The terminal is designed to accept a character memory expansion of 640 additional characters thus enabling 16 lines of 80 characters on the video display as compared with the basic version with 8 lines of 80 characters. (This expansion is a second character memory printed circuit card, with interconnecting cable, which plugs into the logic module, see Foreword.) In this option, the two character memory cards are identical and fully interchangeable. This expansion is easily added as an on-site change if ordered by a customer after receiving the basic terminal.

HARDCOPY RECEIVE-ONLY PRINTER OPTION

The terminal contains a channel which allows operating an optional receive-only printer to provide for hardcopy of displayed data. Information concerning the printer is contained in separate manuals for the specific printer used. This manual's Foreword identifies the printer recommended for use with this terminal.

FUNCTIONAL DESCRIPTION

The Display Terminal contains seven basic functional areas as pointed out in figures 1-3 and 1-4 and listed following.

1) Cathode-ray-tube (CRT) display module with associated drive circuits

2) 640-character read/write memory with 640-character add-on capability

3) Control logic

4) Data entry keyboard

5) Asynchronous modem interface

6) Serial output channel for an optional hardcopy printer

7) Internal power supply

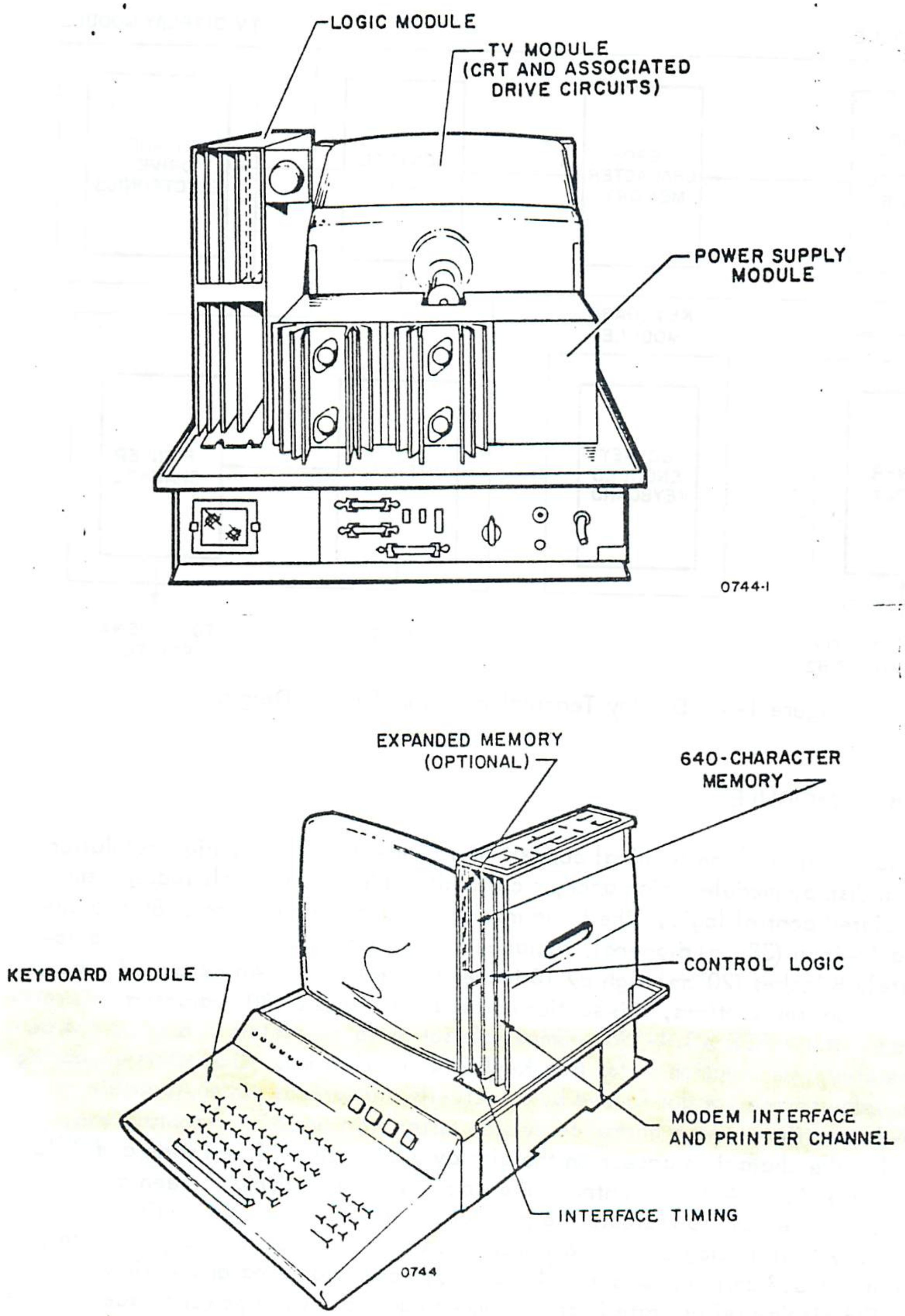

LOGIC MODULE
TV MODULE (CRT AND ASSOCIATED DRIVE CIRCUITS)
POWER SUPPLY MODULE
0744-1
EXPANDED MEMORY (OPTIONAL)
640-CHARACTER MEMORY
CONTROL LOGIC
KEYBOARD MODULE
MODEM INTERFACE AND PRINTER CHANNEL
INTERFACE TIMING
0744

Figure 1-3. Module and Functional Locations

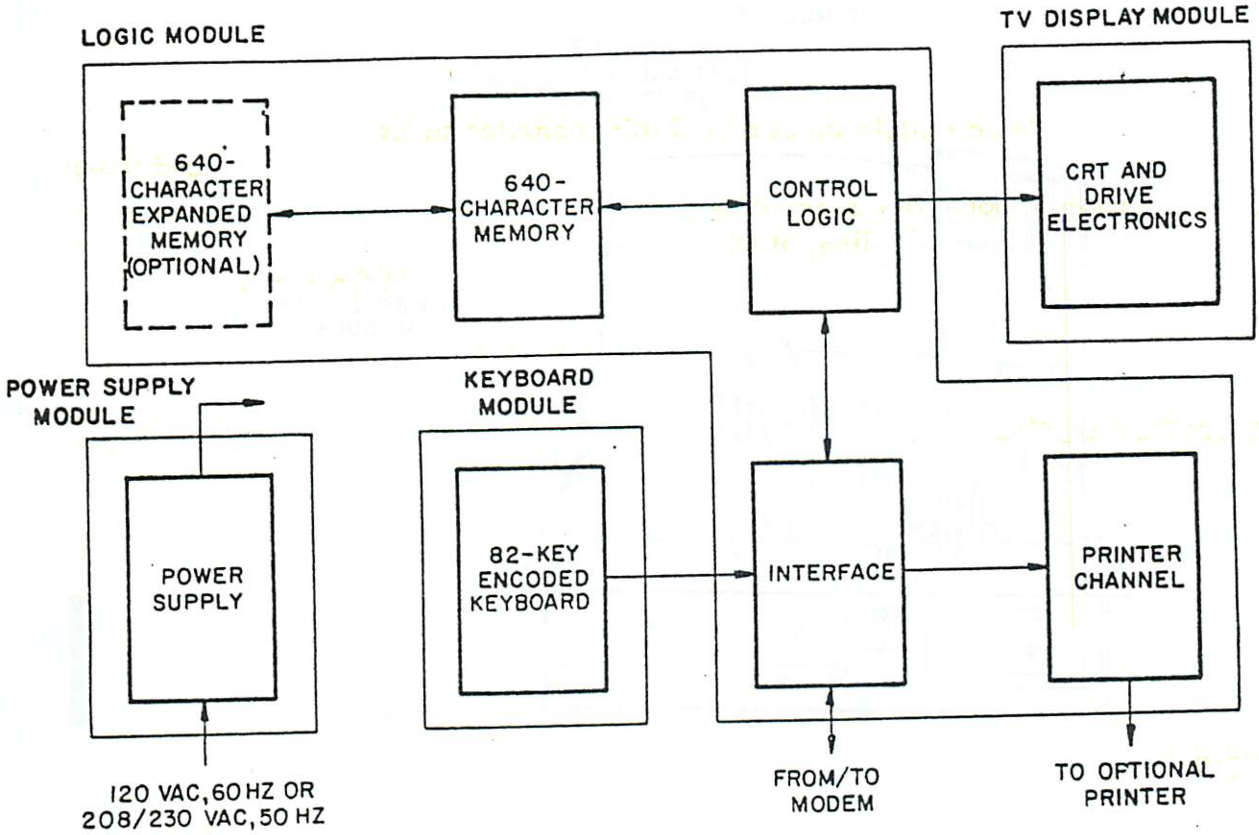


Figure 1-4. Display Terminal Functional Block Diagram

TV DISPLAY MODULE

The display portion of the terminal consists of a field-replaceable, high-resolution, television display module which accepts composite video from the character memory and associated control logic. The basic machine displays eight lines of 80 characters on a 15-inch (38 cm) diagonal, rectangular CRT within a view screen area approximately 8 inches (20 cm) high by 10 inches (25 cm) wide. An expanded character memory option (see Options, this section) provides 16 lines of 80 characters. Display repertoire is the ASCII X3.4-1968 compatible set of 96 characters plus three characters generated from function codes (see Keyboard description). Characters appearing on the display screen are dot formed by selectively unblanking positions within a 5- by 9-dot matrix during a normal television raster scan of 262 horizontal lines. Nominally, the characters appear on the display 3/32 inch (0.3 cm) wide and 3/16 inch (0.5 cm) high. A cursor (entry marker) appears on the display screen as a blinking underline dash to indicate the position where a character will display on the screen. A full display of 8 or 16 lines of 80 characters occupies approximately a 5-1/4 inch (13.3 cm) high and 9-1/4 inch (23.5 cm) wide area of the viewing screen. The display refresh rate is at the same frequency as the power source (50 or 60 Hz).

640-CHARACTER MEMORY

A modular, metal oxide semiconductor (MOS) memory contained on one circuit card within the logic module stores 640, 7-bit character codes for display refresh and input/output data storage. The logic module is designed to accept an additional 640-character memory card as an option. The basic 640-character memory provides storage for the display of 8 lines of 80 characters on the screen and by adding a second identical memory card a total storage for the display of 16 lines of 80 characters can be achieved.

CONTROL LOGIC

The control logic controls the internal functions of the terminal and is contained on one circuit card in the logic module. In addition to timing and sequencing, these circuits include a 256-word, 10-bit MOS read-only memory (ROM) which is programmed with the necessary dot patterns for forming all of the displayable characters on the display screen.

KEYBOARD

The keyboard is the operator input device to the terminal. It is a functionally complete module which supplies 7-bit ASCII codes and operator control signals to the terminal's interface circuits. The keys are of the magnetic reed type. Pressing a key generates one of the ASCII X 3.4-1968 compatible codes from the 96 characters which are displayable or one of the 32 control codes (three of which cause a displayed character). Tables 1-1 and 1-2 show the characters and functions available from the terminal keyboard. These codes travel in parallel to the interface circuits which control keyboard data input routing to the video display and to the communications modem. Upon key depression, the corresponding character or control code is reflected in the view screen data display and/or the code transmits via the interface circuits to the modem, depending on the LOCAL and DUPLEX communications mode switch settings (see Operator Controls and Indicators, Section 2).

The keyboard contains a common typewriter key layout for displayable characters and control functions except for added operator convenience features:

1) A numeric key cluster in addition to the basic numeral row.

2) Frequently used communications control and edit functions available from their separate labeled keys in addition to the basic CNTRL + key (teletypewriter common) operation.

Section 2 of this manual describes keyboard data entry and function operations in detail.

TABLE 1-1. DISPLAYABLE CHARACTER REPERTOIRE

OCTAL CODE	CHARACTER	OCTAL CODE	CHARACTER
040	(space)	123	S
041	! (exclamation point)	124	T
042	" (quotation mark)	125	U
043	# (number or pounds)	126	V
044	$ (dollar sign)	127	W
045	% (percent)	130	X
046	& (ampersand)	131	Y
047	' (apostrophe)	132	Z
050	((left parenthesis)	133	[(left bracket)
051	) (right parenthesis)	134	\ (reverse slant)
052	* (asterisk)	135	] (right bracket)
053	+ (plus)	136	^ (circumflex)
054	, (comma)	137	_ (underline)
055	- (hyphen or minus)	140	` (left single quote mark) NOT AVAILABLE FROM KEYBOARD WHEN 96/64 SWITCH IS SET AT 64.
056	. (period)	141	a
057	/ (slant)	142	b
060	0	143	c
061	1	144	d
062	2	145	e
063	3	146	f
064	4	147	g
065	5	150	h
066	6	151	i
067	7	152	j
070	8	153	k
071	9	154	l
072	: (colon)	155	m
073	; (semicolon)	156	n
074	< (less than)	157	o
075	= (equals)	160	p
076	> (greater than)	161	q
077	? (question mark)	162	r
100	@ (commercial at)	163	s
101	A	164	t
102	B	165	u
103	C	166	v
104	D	167	w
105	E	170	x
106	F	171	y
107	G	172	z
110	H	173	{ (left brace)
111	I	174	| (vertical line)
112	J	175	} (right brace)
113	K	176	~ (equivalent or similar)
114	L	177	▮ (rub out or parity error)
115	M		
116	N		FUNCTIONS
117	O		
120	P	003	▲ (ETX)
121	Q	016	❬ (begin inverse video)
122	R	017	❭ (end inverse video)

NOTE: Control functions are available in addition to the displayable characters shown above. In block mode, these functions are displayable as blinking characters when the CNTRL key or EDIT key is pressed, see Section 2.

TABLE 1-2. CONTROL FUNCTION REPERTOIRE

MNEMONIC	OCTAL CODE	KEYBOARD OPERATION		MNEMONIC	OCTAL CODE	KEYBOARD OPERATION	
		CNTRL + KEY	SEPARATE KEY			CNTRL + KEY	SEPARATE KEY
NUL	000	CNTRL + @		DLE	020	CNTRL + P	
SOH	001	A		DC1	021	Q	
• STX	002	B	STX	DC2	022	R	
• ETX	003	C	ETX	DC3	023	S	
EOT	004	D		DC4	024	T	
ENQ	005	E		• Skip	025	U	→
ACK	006	F		• Line Clear	026	V	LINE CLEAR
BEL	007	G		ETB	027	W	
• BS	010	H	←	• Clear	030	X	CLEAR
HT	011	I		• Reset	031	Y	RESET
• LF	012	J	↓	• Cursor Up	032	Z	↑
VT	013	K		ESC	033	[	ESCAPE
FF	014	L		FS	034	\	FS
• CR	015	M	RETURN	GS	035	]	GS
• SO	016	N		RS	036	^	RS
• SI	017	CNTRL + O		US	037	CNTRL + -	US

- Use CNTRL + key or separate key, where available, as desired when operating in conversational mode.

Use CNTRL + key in block mode only to enter a control code as part of a message intended to transmit to a remote equipment for performance.

Use separate key, where available, in block mode to transmit a block message (STX) or perform edit and cursor control functions on a displayed message.

INTERFACE

The asynchronous interface circuits control all data routing within the terminal and between the terminal and the communications modem. These circuits are contained on two circuit cards within the logic module.

The interface is designed to operate with communications signals compatible to EIA Standard RS-232-C such as the AT&T 103 series data sets, or equivalent. This interface is compatible to CCITT V.24. This type of modem communicates word-by-word with 8-bit serial data words (including parity). The interface communicates at manually selected transmission rates of 75, 110, 150, 200, 300, 600, 1200, 1800, 2400, 4800, and 9600 bits per second. The circuits do all serial-to-parallel and parallel-to-serial conversion, perform all modem control, and (during transmission) perform the data-clocking function and parity checking (if any).

Data and control function routing performed by the interface between the keyboard, modem, control, and printer channel depends on the settings of the transmission and printer control switches described in Section 2.

Figure 1-5 shows the signals required for communication between the modem interface connector located on the back panel of the terminal and an AT&T 103 series (or equivalent) modem. The maximum cable length allowable for reliable operation is 50 feet (15.2m). The following paragraphs define these signals and their operable voltage levels.

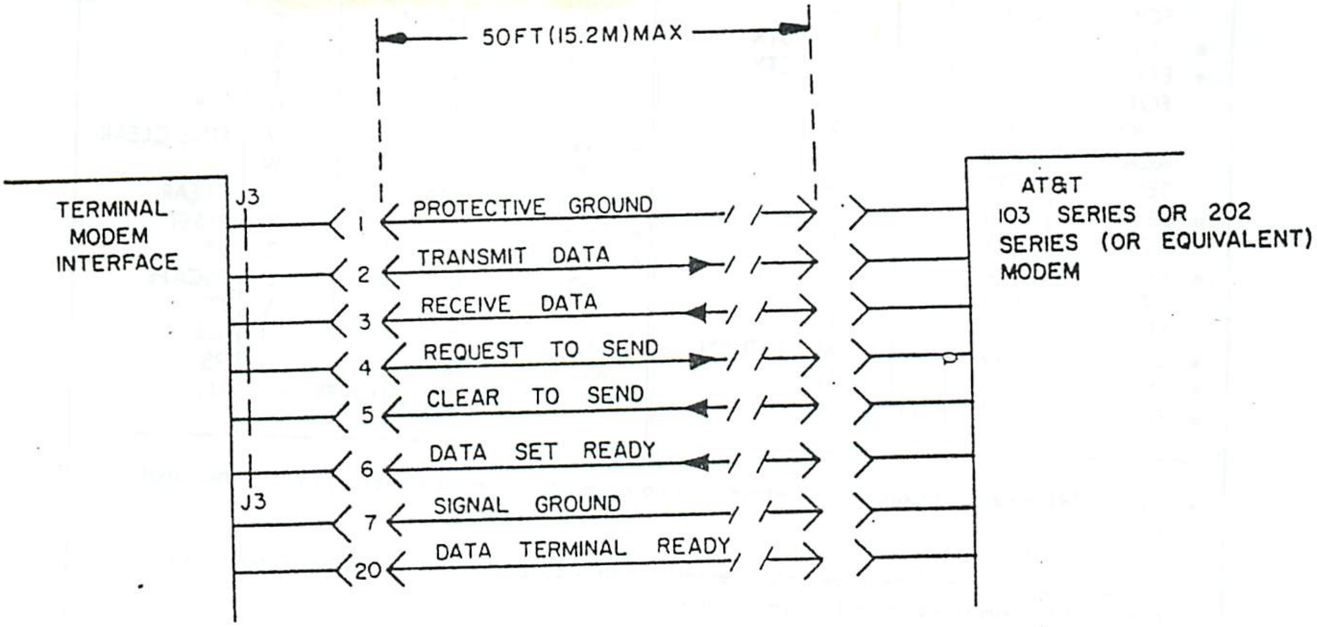


Figure 1-5. Modem Interface Signals

Protective Ground

This line connects to the frame of the modem and is grounded through the modem's ac power system. It also connects to the frame of the terminal and is tied to ground through the terminal's ac power system. To maintain proper voltage reference, the modem and the terminal should use the same ac power receptacle.

Transmit Data

Data travels from the terminal interface circuits to the modem via the transmit data line. When the interface is not transmitting data, the terminal holds the transmit data line to a logical 1 (more negative than -3 volts).

Receive Data

Data travels from the modem to the terminal interface circuits via the receive data line. When the modem is not transferring data to the terminal, the modem holds the receive data line to a logical 1 (more negative than -3 volts).

Request to Send

The terminal interface circuits hold the request to send line at a logical 0 (more positive than +3 volts) to initiate a transmit operation. The logical 1 state (more negative than -3 volts) on the request to send line signifies that the terminal interface circuits are in a receive mode.

Clear to Send

The modem sets the clear to send line to a logical 0 (more positive than +3 volts) in response to the request to send signal from the terminal interface circuits. The clear to send line remains active until the interface drops the request to send line to negative (inactive). At this time, the modem drops the clear to send line (inactive) and the terminal interface circuits return to a receive communications mode.

Data Set Ready

The modem makes this signal line active (more positive than +3 volts) when the modem is in the data mode. This means that the modem is not in the idle or talk mode, nor is it without power.

Data Terminal Ready

With an internal data terminal ready (DTR) strap option in place (see Strap Options, Section 2), this signal is active (more positive than +3 volts) when power is on to the terminal. With the internal strap removed, this signal is active only when the terminal is in remote operating mode (LOCAL indicator extinguished). The unit is shipped with strap removed.

Signal Ground

Signal ground is the voltage from which the control and data signal voltage levels are referenced. This ground level is connected to protective ground and ac power ground in the display portion of the terminal.

PRINTER OUTPUT CHANNEL

The terminal is designed with a serial printer output channel accompanying the modem interface on the two interface cards contained in the logic module. This channel will accommodate a low-speed hardcopy printer which the customer may obtain to complement the basic terminal. Either full-screen printout or character-by-character printout of displayed data is available with the printer controls included in the basic terminal, see Operator Controls and Indicators, Section 2. The terminal will obey a remote device command to print out the displayed page, see Terminal Control Codes, Section 3. The printer channel presents data to a printer on a 7-bit ASCII character word basis, bit-by-bit serially. Generally, all character codes 040_8 — 177_8 shown in table 2-1 and the control codes for backspace (010_8), line feed (012_8), and carriage return (015_8) may be used by an associated printer. Refer to the reference manual covering the printer for exact code uses.

A printer may be used exclusively by one terminal or be shared by up to eight terminals. This is possible since the printer/interface channel contains printer-in-use recognition circuits which indicate when another terminal is using the printer.

Two printer interface connectors are located at the rear of the terminal on the connector panel. These two connectors are wired internally in a daisy chain fashion with pin 1 of J1 connected to pin 1 of J2, pin 2 of J1 connected to pin 2 of J2, etc., (see figure 1-6). This allows a terminal to be connected with as many as seven other terminals and a single printer (see figure 1-7). The total cable length that can be used in any printer application is 1500 feet (458m) maximum. Figure 1-6 identifies the required printer interface signals. The communication technique is a bidirectional, differential, long-line driver/receiver combination. Thus each interface signal requires a negative (-) and a positive (+) line as a twisted pair as shown in figure 1-6. The following paragraphs describe printer interface line function.

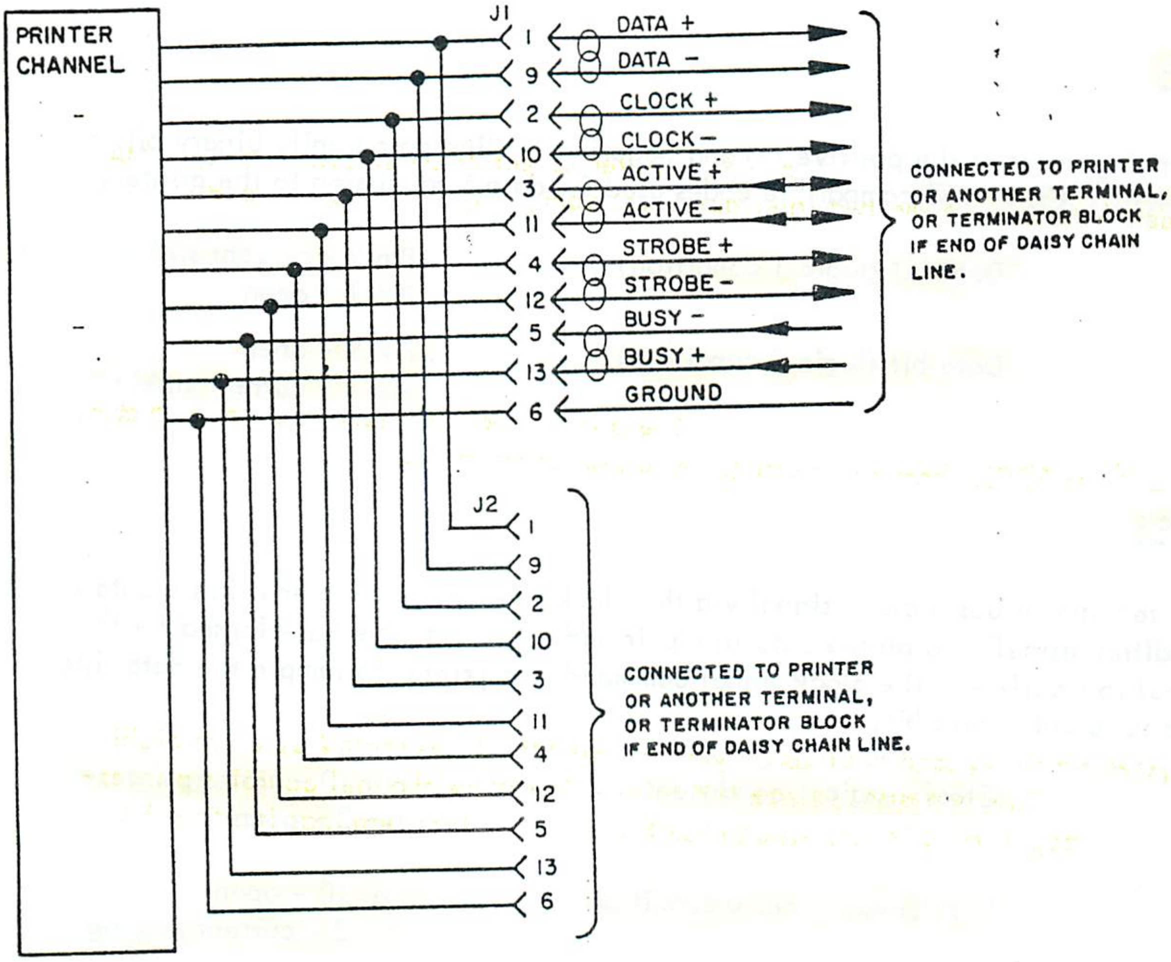
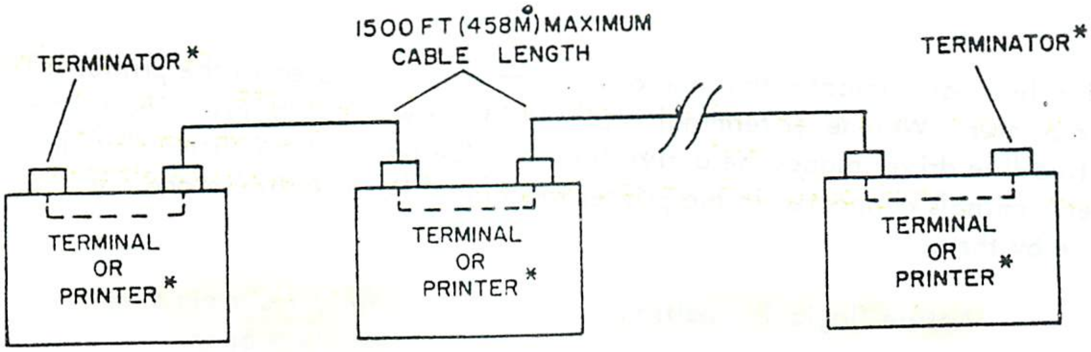

PRINTER CHANNEL
J1
1
9
2
10
3
11
4
12
5
13
6
DATA +
DATA −
CLOCK +
CLOCK −
ACTIVE +
ACTIVE −
STROBE +
STROBE −
BUSY −
BUSY +
GROUND
CONNECTED TO PRINTER OR ANOTHER TERMINAL, OR TERMINATOR BLOCK IF END OF DAISY CHAIN LINE.
J2
1
9
2
10
3
11
4
12
5
13
6
CONNECTED TO PRINTER OR ANOTHER TERMINAL, OR TERMINATOR BLOCK IF END OF DAISY CHAIN LINE.

Figure 1-6. Printer Channel I/O Signals



* From one to eight terminals may share one printer. The printer may be located between terminals on the interface line or on either end. A terminator block, part no. 62078900, must be installed in the unused connector of the device (terminal or printer) located on each end of the interface.

Figure 1-7. Terminal/Printer Interface

Data

Changing states of the positive (+) and negative (-) line pair signify binary bits of the ASCII X3.4-1968 compatible codes used for data transmission to the printer.

Data bit (logic 1 condition) . . . . Pin 9 - current sinking
Pin 1 + open

Data bit (logic 0 condition) . . . . Pin 9 - open
Pin 1 + current sinking

Clock

The terminal issues a clock signal via the clock line pair whenever it has a data bit condition established on the data line pair and sufficient time has elapsed for the signal to stabilize. The clock signal commands the printer to sample the data line pair for a valid data bit.

Clock (logic 1 condition) . . . . Pin 10 - current sinking
Pin 2 + open

Not Clock (logic 0 condition) . . . . Pin 10 - open
Pin 2 + current sinking

Active

The active line pair indicates that one of the terminals connected to the printer is using the printer. Whichever terminal is placed in use with the printer, the terminal's active line driver places the active line in a "being used" condition so that any other terminals connected to the printer recognize that it is in use and not accessible by them.

Active (logic 1 condition) . . . . Pin 3 + current sinking
Pin 11 - open

Not Active (logic 0 condition) . . . . Pin 3 + open
Pin 11 - current sinking

Strobe

The terminal issues a strobe signal via the strobe line pair whenever it has completed sending all seven data bits of ASCII code to the printer via the data line and clock signal operations. The strobe signal commands the printer to translate and execute the complete data word it has just received.

Strobe (logic 1 condition) . . . . Pin 12 - current sinking
Pin 4 + open

Not Strobe (logic 0 condition) . . . . . . Pin 12 - open
Pin 4 + current sinking

Busy

The printer uses the busy line pair to indicate to all terminals connected to it that it is internally busy (during print head return, etc.) and cannot receive data.

Busy (logic 1 condition) . . . . Pin 5 - open
Pin 13 + current sinking

Not Busy (logic 0 condition) . . . . Pin 5 - current sinking
Pin 13 + open

Ground

The ground line establishes a common reference for signal levels between terminals and the printer. Pin 6 carries the ground.

POWER SUPPLY

The power supply is a solid-state, full-wave transformer type. The power supply circuits in equipment CC5A5-A use 120 vac, 60-Hz primary power to supply internal required power of +5 vdc, -12 vdc, +73 vdc, and 6.3 vac. The power supply of the CC5A6-A equipment uses 208/230 vac, 50-Hz primary power to provide the same internal power requirements.

The control logic and keyboard use +5 vdc. The keyboard also uses -12 vdc. The +12 vdc drives the character refresh memory. The +73 vdc drives the TV module circuits. The 6.3 vac supplies current to the CRT heater element.

ELECTRICAL AND PHYSICAL CHARACTERISTICS

Power Requirements

Equipment CC5A5-A: 120 vac, 60 Hz, 1.5 amp max
Equipment CC5A6-A: 208/230 vac, 50 Hz, 0.75 amp max

Environment

Operating Temperature: +40° to +120° F (+4° to +49° C)
Storage Temperature: -30° to +150° F (-34° to +66° C)

Operating Humidity: 10 to 90% - relative - no condensation
Storage Humidity: 5 to 95% - relative - no condensation

Operating Altitude: -1000 to +10,000 ft (-305 to +3048m)
Storage Altitude: -1000 to +15,000 ft (-305 to +4572m)

Heat Dissipation

700 Btu/hr (176.4 kg-cal/hr)

Dimensions and Weight

Height: 18 in. (46 cm)
Width: 18 in. (46 cm)
Depth: 29 in. (74 cm)
Weight: 65 lb (29.5 kg)

Internal Construction

Modular - containing: (see figure 1-3)	TV Module Logic Module Keyboard Module Power Supply

OPERATION 2

This section describes how to use the controls, indicators, and data entry keyboard of the Display Terminal for telecommunications operations. Operator data entry and control tasks are simple and easy to perform and have been designed with operator convenience in mind.

CONTROLS AND INDICATORS

Figures 2-1 and 2-2 show controls and indicators provided with the terminal. These controls and indicators are described in two tables: table 2-1, operator associated and table 2-2, maintenance associated.

APPLYING POWER TO TERMINAL

To apply power to the terminal, use the following procedure.

1) Press the POWER switch/indicator (it should light).

2) Wait 30 seconds for cursor to appear on the viewing screen.

3) If brightness of viewing screen is too bright, adjust the brightness knob as necessary (terminal should not operate with excessive display screen brightness or displayed information will be distorted and the life of the CRT display tube may be shortened).

4) If the cursor does not appear after checking brightness in step 3 above, push the red circuit breaker on the connector panel; reapply power.

5) With keyboard unlocked, and LOCAL mode set, press several alphanumeric keys to check display.

6) If the cursor still does not display or if key depressions for characters or cursor controls fail to display, contact the equipment serviceman or refer to the Display Terminal On-Site Maintenance Manual.

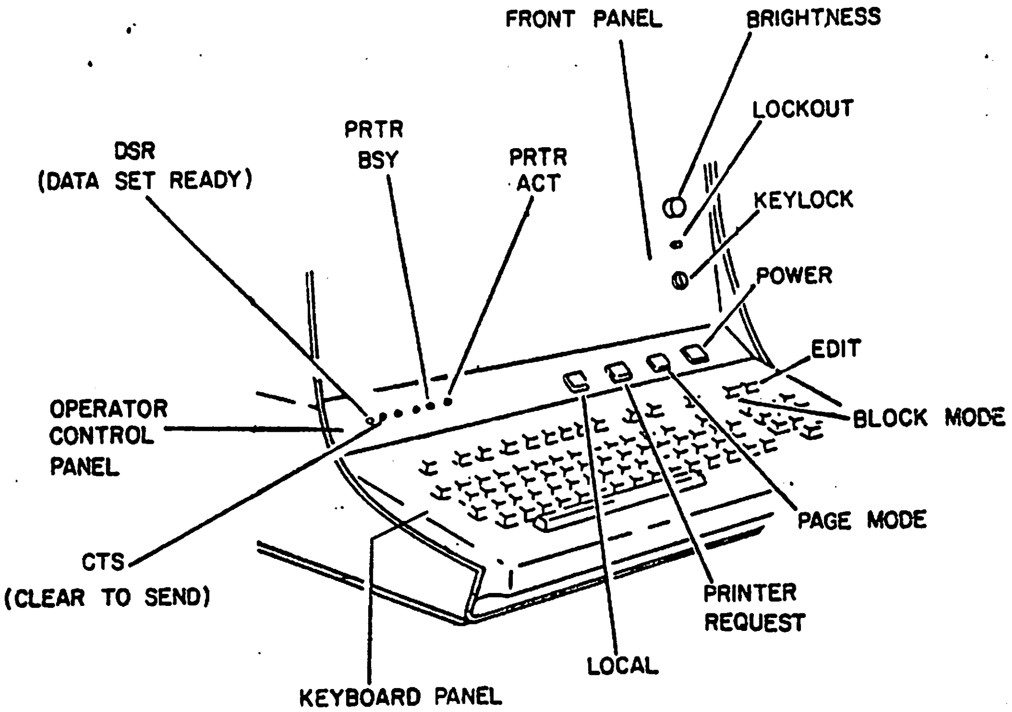


Figure 2-1. Front, Operator Control, and Keyboard Panels

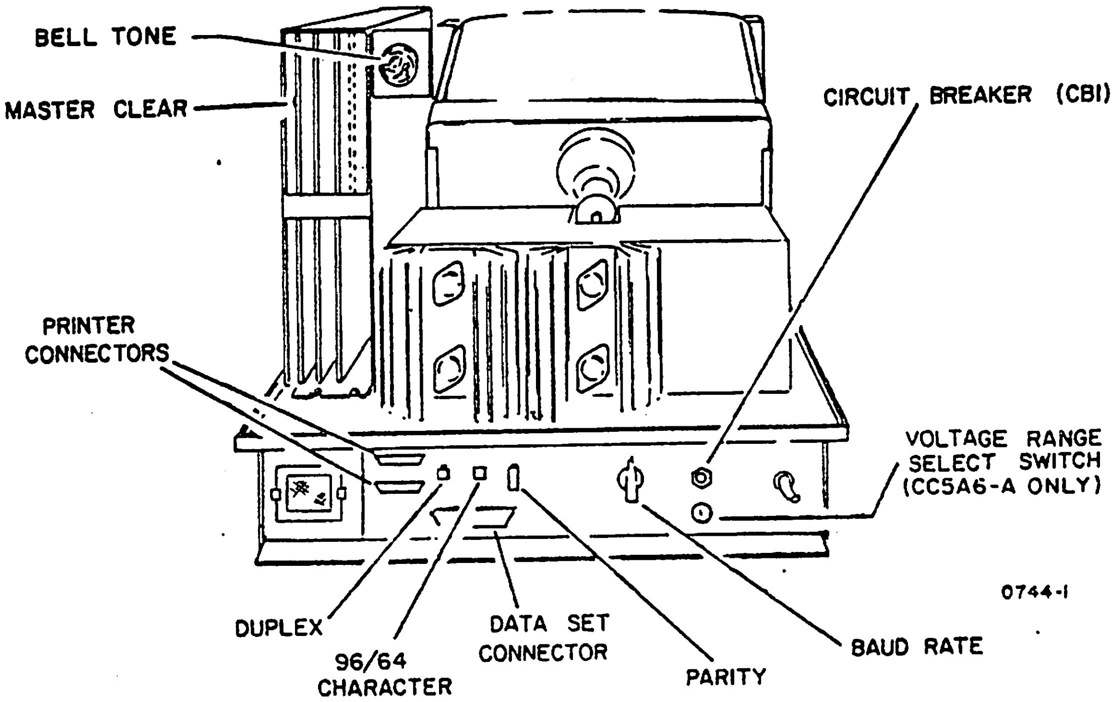


Figure 2-2. Connector Panel

TABLE 2-1. OPERATOR CONTROLS AND INDICATORS

CONTROL/ INDICATOR	TYPE	LOCATION	FUNCTION
POWER	Pushbutton Switch/Indicator	Operator Control Panel	Applies primary power to terminal when illuminated. Application of primary power sets all logic elements to initial or starting condition.
BRIGHTNESS	Rotary Potentiometer Control	Front Panel	Allows adjustment of video intensity used in the display. CCW - reduces intensity CW - increases intensity
KEYLOCK	Key-Operated Lock-Switch	Front Panel	Allows manually locking out of the keyboard, preventing generation of input codes. Transmit function of terminal disabled when keyboard locked out; however, receive and print functions stay active.
LOCKOUT	Indicator	Front Panel (above keylock switch)	Illuminated when keyboard disabled by keylock switch or data transfer operations.
LOCAL	Pushbutton Switch/Indicator	Operator Control Panel	When illuminated, transmit circuits of terminal disabled. Keyboard data then automatically passes to memory for display. Data from communications modem still allowed and takes precedence over keyboard originated data. Local mode is commonly used when testing the terminal.
DUPLEX	2-Position Slide Switch	Connector Panel	Full: All keyboard generated codes routed directly to communications modem. Codes not stored in memory or displayed unless returned from remote equipment. Local mode disables this function. Half: All keyboard generated codes routed to communications modem and also to display memory for subsequent display. Local mode disables transmission to modem.
BLOCK MODE	2-Position Pushbutton Switch	Keyboard Panel	All keyboard generated codes routed to display memory for display. Transmission of data occurs only when STX key is pressed.
EDIT	2-Position Pushbutton Switch	Keyboard Panel	When pressed, allows any control function codes entered in display memory to appear on the view screen as their assigned blinking character (see table 2-5).

TABLE 2-1. OPERATOR CONTROLS AND INDICATORS (CONT)

CONTROL/ INDICATOR	TYPE	LOCATION	FUNCTION
PAGE MODE	Pushbutton Switch/Indicator	Operator Control Panel	Enables page mode display when illuminated. Enables scroll mode display when extinguished. See "Data Entry Cursor."
DSR	Indicator	Operator Control Panel	Illuminated when terminal modem indicates it has power on and is in the data mode. Must be on to receive data. For maintenance use to check presence of usable carrier signal from terminal.
CTS	Indicator	Operator Control Panel	Illuminated when modem activates clear to send line. Must be on to start transmit. For maintenance use to check modem condition for transmit to modem.
BAUD RATE.	11-Position Rotary Switch	Connector Panel	Allows the baud rate of the terminal to be switch selected to match the baud rate of the system. 75, 110, 150, 200, 300, 600, 1200, 1800, 2400, 4800, and 9600 baud rate selection is available.
PARITY	3-Position Slide Switch	Connector Panel	Even: Data words transmitted with even parity and checked for even parity when received. Odd: Data words transmitted with odd parity and checked for odd parity when received. Center Position: Parity disregarded.
Bell Tone	Audible Tone	Internal	Sounds tone when cursor enters 73rd character position of any display line to indicate approaching end of line. Sounds tone if bell code (007_8) generated from keyboard or received from communications line.
CB1	2-Position Pushbutton	Connector Panel	Pressing this red pushbutton resets the internal circuit breaker if it opened due to overload.
Keyboard Keys	Magnetic-Reed Momentary Contact Switches	Keyboard Panel	Keys enable operator to enter alphanumeric characters for message composition on the display screen; also provides initiation of communication functions. See Data Entry Keyboard for details.
96/64 CHARACTER	2-Position Slide Switch	Connector Panel	96 Position: Terminal will generate and recognize all characters shown in table 2-3 when entered from keyboard. 64 Position: Terminal will not generate lower case alphabet or the 5 special characters when entered from keyboard; but will recognize all characters upon reception.

TABLE 2-1. OPERATOR CONTROLS AND INDICATORS (CONT)

CONTROL/ INDICATOR	TYPE	LOCATION	FUNCTION
PRINTER REQUEST	Pushbutton Switch/Indicator	Operator Control Panel	For use with hardcopy printer. Illuminated position requests hardcopy printer channel. When the printer is available, it will go on line with the terminal. Then, if the baud rate is not over 300, all communications as received or transmitted are printed. When extinguished, the PRINT key on keyboard must be pressed to obtain desired hardcopy of displayed data or the print command (021_8) must be received from remote equipment.
PRTR BSY	Indicator	Operator Control Panel	For use with hardcopy printer. When illuminated, indicates printer is busy with this terminal or another one sharing printer (eight terminals may share one printer). If PRINT key or PRINTER REQ key is depressed when PRTR BSY is lit, print operation will terminate.
PRTR ACT	Indicator	Operator Control Panel	For use with hardcopy printer. Illuminated only when terminal is transferring data to printer or when terminal has exclusive control of printer via an honored printer request operation (this is considered as the printer on line mode).
PRINT Key	Magnetic-Reed Momentary-Contact Switch	Keyboard Panel	For use with hardcopy printer. With the printer off line and not busy (see above), pressing PRINT key sets the cursor to the start of displayed video page and advances cursor through entire display. During this time, the entire displayed page transfers to printer. This print operation disables any data entry operations from the keyboard and disables transmit to modem. Receiving data from modem interface aborts a print operation.

TABLE 2-2. MAINTENANCE CONTROLS AND INDICATORS

CONTROL/ INDICATOR	TYPE	LOCATION	FUNCTION
DSR	Indicator	Operator Control Panel (see figure 2-1)	Illuminated when terminal modem indicates it has power on and is in the data mode.
CTS	Indicator	Operator Control Panel (see figure 2-1)	Illuminated when modem activates clear to send line (see Modem Interface, this section).
MASTER Clear	Pushbutton Switch	Logic Module (see figure 2-2)	Depressing clears internal circuits to initial or starting logic condition.
Voltage Range Select (CC5A6-A only)	2-Position Rotary Switch	Connector Panel (see figure 2-2)	Acts to compensate for different nominal ac power source voltages. Normal: For 210 to 256 vac, 50-Hz power source. Low Line: For 187 to 230 vac, 50-Hz power source.

SEND/RECEIVE MODE OPERATION

The terminal can be operated in several modes, some of which are interrelated to perform a variety of functions: to aid in understanding the descriptions of keyboard codes and control functions, a brief summary of send/receive mode operation follows.

LOCAL MODE

Whenever the terminal is set for local operation (LOCAL indicator/switch illuminated), regardless of the DUPLEX mode setting, all codes generated by key depressions bypass the transmit circuits and flow through the interface circuits to the receive circuits for subsequent display. The control circuits hold the beam blank/unblank information necessary to display each character. They also keep track of all displayable data entry points and the location of the cursor. If a displayable character key or function key entry is made, the control circuits direct the TV module with the correct video pulses for the entry or change of the display. The local operation mode provides a convenient method to check operation of the keyboard and video display independent of its communications system. However, it should be kept in mind that the terminal will still receive data from the communications modem while operating in the local mode.

BLOCK MODE

With the BLOCK MODE switch depressed and the terminal operating in conversational mode, all octal-producing keyboard entries are stored in the display memory as part of a message. This message is directed by the control logic for display by the TV module. To transmit messages to remote equipment via the modem, the operator must press the STX key. The terminal will receive data while operating in block mode.

CONVERSATIONAL MODE, FULL DUPLEX (ECHO PLEX)

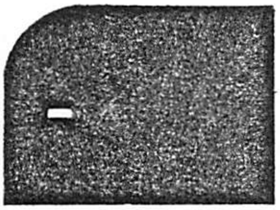
When the terminal is set for conversational mode operation and the DUPLEX switch is set at FULL, all keyboard-initiated codes transmit via the interface circuits directly to the communications modem for presentation at remote equipment. In this communications condition, no display operation occurs unless character codes or control codes are returned ("echoed") to the terminal from remote equipment. Only eleven control codes and the bell code will affect the terminal. All other control codes are ignored by the terminal when received.

CONVERSATIONAL MODE, HALF DUPLEX

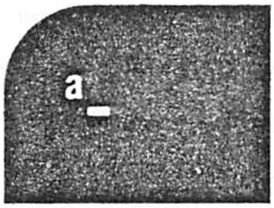
In conversational mode with the DUPLEX switch set at HALF, all keyboard-initiated codes transmit via the interface circuits to the communications modem and also travel to control logic for subsequent display action. The terminal will receive data in this operating mode.

DATA ENTRY CURSOR

The display screen contains a cursor (position marker) that indicates where the next character will be displayed on the screen. The cursor is a blinking underline symbol displayed below a character position and it blinks at approximately three times a second. In typical operation, when a character key is depressed, the character shown on the key displays above the cursor on the display screen. The cursor then advances to the next character position to show where the next character will be displayed.



BLANK DISPLAY
WITH CURSOR



DISPLAY AFTER
PRESSING CHARACTER
KEY A

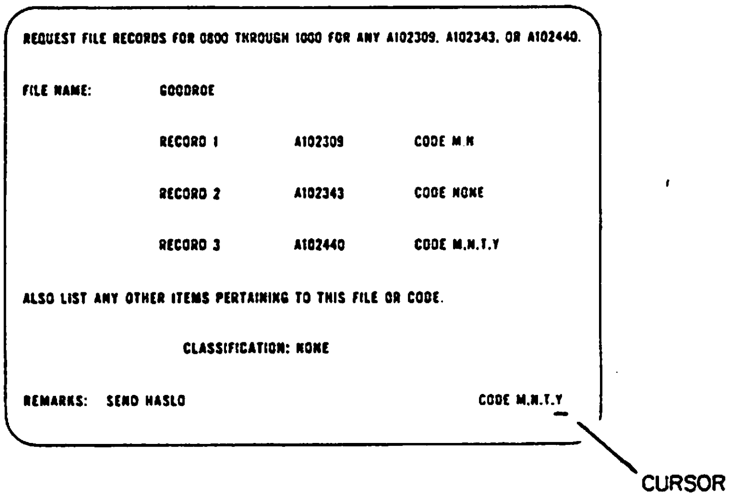
DISPLAY AFTER
PRESSING A AND B
CHARACTER KEYS

NOTE

> The cursor and displayed characters appear as white forms on a black background unless contained in an inverse video field (see Inverse Video, this section).

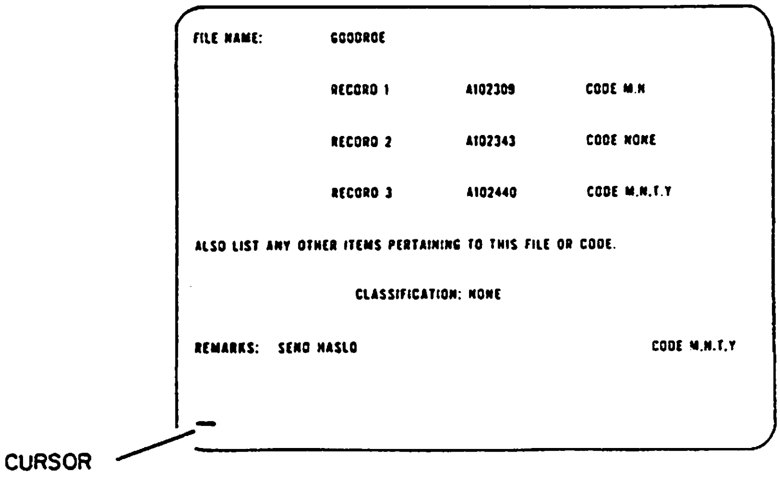
When operating the Display Terminal in the page mode, pressing the CLEAR key will remove all characters from the display screen and place the cursor at the first character position of the top line. As each character is entered from the keyboard the cursor will move one character position to the right. As the cursor is advanced from the 72nd position to the 73rd position, an audible tone will sound indicating the proximity of the end of the line. When the cursor is advanced from the 80th character position, it automatically moves to the first character position of the next lower line. This process will continue until the last character position of the last line is reached. Further data entry with the character keys will cause the newly entered character data to replace the character displayed on the screen.

Disabling the page mode will place the display in scroll mode. Pressing the CLEAR key will remove all characters from the display screen and place the cursor in the first character position of the last line. Advancing the cursor from the 80th character position will cause the last line to move up one line position and the cursor to return to the first character position of the last line. This process will be repeated until all lines of the screen are filled. With the screen filled, advancing the cursor from the 80th position will move the top line of characters off the screen and all other lines up one line position (figure 2-3) and return the cursor to the first position of the last line. In addition to the end of line/end of page cursor movements described above, the cursor may be moved any place on the screen with the cursor control keys (←, →, ↑, ↓, RESET, RETURN) without altering the characters displayed on the screen.



```
REQUEST FILE RECORDS FOR 0800 THROUGH 1000 FOR ANY A102309. A102343. OR A102440.

FILE NAME:          GOODROE

                    RECORD 1        A102309         CODE M.N

                    RECORD 2        A102343         CODE NONE

                    RECORD 3        A102440         CODE M.N.T.Y

ALSO LIST ANY OTHER ITEMS PERTAINING TO THIS FILE OR CODE.

                        CLASSIFICATION: NONE

REMARKS:   SEND HASLO                                         CODE M.N.T.Y
```

PRESSING ANY KEY WHICH ADVANCES THE CURSOR FROM THE LAST POSITION IN THE LAST LINE, WILL MOVE THE CURSOR TO THE FIRST POSITION OF THE LAST LINE.

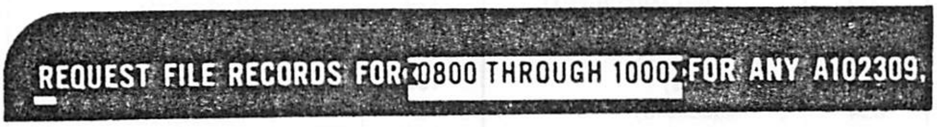


```
FILE NAME:          GOODROE

                    RECORD 1        A102309         CODE M.N

                    RECORD 2        A102343         CODE NONE

                    RECORD 3        A102440         CODE M.N.T.Y

ALSO LIST ANY OTHER ITEMS PERTAINING TO THIS FILE OR CODE.

                        CLASSIFICATION: NONE

REMARKS:   SEND HASLO                                         CODE M.N.T.Y
```

Figure 2-3. Display Scroll Operation (Eight-Line Basic Display)

INVERSE VIDEO

A special code to start inverse video field and one to end the field can be generated from the keyboard or received from remote equipment via the communications modem. That portion of the displayed data included between the start and end codes appear as black characters on a white field. There are no limitations as to the location, number of inverse video areas, or to the total area that may be inverted. The start inverse video code (016_8) is generated from the keyboard by pressing the CNTRL key in conjunction with the N character key. The end inverse video code (017_8) is generated from the keyboard by using the CNTRL key with the letter "O" character key. Inverse video fields are bracketed on the display with the start inverse video character (❮) and the end inverse video character (❯).



REQUEST FILE RECORDS FOR ❮0800 THROUGH 1000❯ FOR ANY A102309.

DATA ENTRY KEYBOARD

The data entry keyboard (figure 2-4) contains 49 alphanumeric/character keys arranged in a standard typewriter pattern including space bar, a cluster of 10 numeric keys, plus a decimal point key, 5 keyboard control keys (SHIFTS, REPEAT and CNTRL), 15 control function keys and 3 special control function keys. Pressing any character or control function key causes generation of a unique 7-bit ASCII-X3.4-1968 compatible code determined by hardware for that key (see tables 2-3 through 2-5). If a second character or function key is depressed while the first key is still down, the second key does not interfere with the first key. The second key produces it's code only after the first key is released.

After each character entry, the cursor advances to the next character display position. The ability of the keyboard to produce lowercase letters and five special characters (pointed out in table 2-3) is available only when the character set switch, located on the back panel, is in the 96 character position. The various key functions available are described in detail in the Operators Guide for this terminal. A brief description of their operation is provided in the following paragraphs.

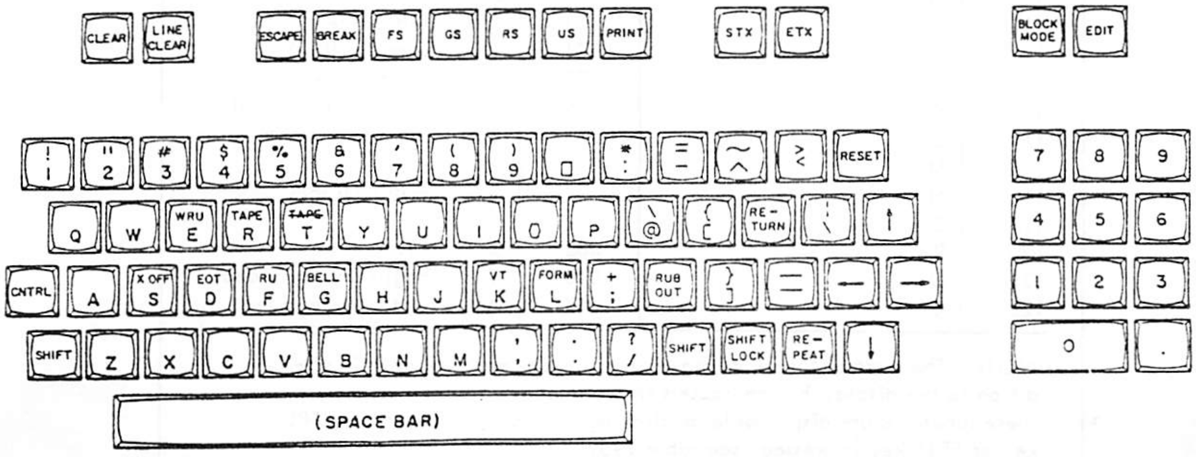


Figure 2-4. Data Entry Keyboard

TABLE 2-3. DISPLAYABLE CHARACTER REPERTOIRE

OCTAL CODE	CHARACTER	OCTAL CODE	CHARACTER	
040	(space)	123	S	
041	! (exclamation point)	124	T	
042	" (quotation mark)	125	U	
043	# (number or pounds)	126	V	
044	$ (dollar sign)	127	W	
045	% (percent)	130	X	
046	& (ampersand)	131	Y	
047	' (apostrophe)	132	Z	
050	((left parenthesis)	133	[(left bracket)	
051	) (right parenthesis)	134	\ (reverse slant)	
052	* (asterisk)	135	] (right bracket)	
053	+ (plus)	136	^ (circumflex)	
054	, (comma)	137	_ (underline)	
055	- (hyphen or minus)	140	` (left single quote mark)	NOT AVAILABLE FROM KEYBOARD WHEN 96/64 SWITCH IS SET AT 64.
056	. (period)	141	a	
057	/ (slant)	142	b	
060	0	143	c	
061	1	144	d	
062	2	145	e	
063	3	146	f	
064	4	147	g	
065	5	150	h	
066	6	151	i	
067	7	152	j	
070	8	153	k	
071	9	154	l	
072	: (colon)	155	m	
073	; (semicolon)	156	n	
074	< (less than)	157	o	
075	= (equals)	160	p	
076	> (greater than)	161	q	
077	? (question mark)	162	r	
100	@ (commercial at)	163	s	
101	A	164	t	
102	B	165	u	
103	C	166	v	
104	D	167	w	
105	E	170	x	
106	F	171	y	
107	G	172	z	
110	H	173	{ (left brace)	
111	I	174	| (vertical line)	
112	J	175	} (right brace)	
113	K	176	~ (equivalent or similar)	
114	L	177	▮ (rub out or parity error)	
115	M			
116	N		FUNCTIONS	
117	O			
120	P	003	▲ (ETX)	
121	Q	016	❮ (begin inverse video)	
122	R	017	❯ (end inverse video)	

NOTE: The control functions shown in table 2-4 are available in addition to the displayable characters shown above. In block mode, these functions are displayable as blinking characters when the CNTRL key or EDIT key is pressed, see table 2-5.

TABLE 2-4. CONTROL FUNCTION REPERTOIRE

MNEMONIC	OCTAL CODE	KEYBOARD OPERATION		MNEMONIC	OCTAL CODE	KEYBOARD OPERATION	
		CNTRL + KEY	SEPARATE KEY			CNTRL + KEY	SEPARATE KEY
NUL	000	CNTRL + @		DLE	020	CNTRL + P	
SOH	001	A		DC1	021	Q	
STX	002	B	STX	DC2	022	R	
• ETX	003	C	ETX	DC3	023	S	
EOT	004	D		DC4	024	T	
ENQ	005	E		• Skip	025	U	→
ACK	006	F		• Line Clear	026	V	LINE CLEAR
BEL	007	G		ETB	027	W	
• BS	010	H	←	• Clear	030	X	CLEAR
HT	011	I		• Reset	031	Y	RESET
• LF	012	J	↓	• Cursor Up	032	Z	↑
VT	013	K		ESC	033	[	ESCAPE
FF	014	L		FS	034	\	FS
• CR	015	M	RETURN	GS	035	]	GS
• SO	016	N		RS	036	^	RS
• SI	017	CNTRL + O		US	037	CNTRL + -	US

NOTE: The symbol (•) denotes control functions which may be entered by a single key marked with the respective control function. SO and SI must always be entered by CNTRL + key. The display operation assigned to these codes will be performed when the codes are received from a remote device. All other codes are ignored when received from a remote terminal except for the bell tone.

TABLE 2-5. KEYBOARD-ENTERED CONTROL FUNCTION IDENTIFYING CHARACTERS

OCTAL CODE	BLINKING CHARACTER	CONTROL FUNCTION	OCTAL CODE	BLINKING CHARACTER	CONTROL FUNCTION
000	@	NUL	020	P	DLE
001	A	SOH	021	Q	DC1
002	B	STX	022	R	DC2
003	See Note	ETX	023	S	DC3
004	D	EOT	024	T	DC4
005	E	ENQ	025	U	SKIP (→)
006	F	ACP	026	V	LINE CLEAR
007	G	BEL	027	W	ETB
010	H	BS (←)	030	X	CLEAR
011	I	HT	031	Y	RESET
012	J	LF (↓)	032	Z	CURSOR UP (↑)
013	K	VT	033	[	ESC
014	L	FF	034	\	FS
015	M	CR	035	]	GS
016	See Note	SO	036	^	RS
017	See Note	SI	037	—	US

NOTE: Control functions SO (begin inverse video) and SI (end inverse video) always display as ❮ and ❯ respectively. The ETX function produces the end of text character (▲) when initiated by CNTRL plus 'C' key depression or initiated by ETX key. The ETX and inverse video characters do not blink in block mode. They are visible on the display with or without the CNTRL key or the EDIT key depressed.

KEYBOARD CONTROL KEYS

The keyboard control keys are: SHIFT (2), SHIFT LOCK, REPEAT, and CNTRL. They do not generate displayable or control function codes unless depressed in conjunction with other keys.

SHIFT and SHIFT LOCK Keys

The two SHIFT keys and the SHIFT LOCK key enable selection of the upper case characters on the double-character keys when the character set switch is in the 96 character position. Pressing the SHIFT LOCK key locks the keyboard in uppercase position, and pressing the adjacent SHIFT key releases the keyboard from uppercase operation. With the character set switch in the 64-character position, the SHIFT keys have no effect; only the characters indicated in table 2-3 will be displayed.

REPEAT Key

Pressing the REPEAT key in conjunction with any code-producing key or combination of keys causes the particular character or control code for that key(s) to be generated and displayed/transmitted at approximately ten times per second. The key is an operator convenience for entering repeated characters.

CNTRL Key

Pressing the CNTRL key in conjunction with any key as outlined in table 2-4 generates the control function code shown. In block mode operation, all control function codes generated this way are stored for transfer. For identification purposes, they appear on the terminal display screen as blinking characters when either the CNTRL key or the EDIT key is depressed. Table 2-5 shows the relationship of blinking characters to the control function codes stored. In full or half duplex operating modes, control function codes generated by CNTRL plus key depression transmit and display according to full and half duplex rules the same as individual key entries for control functions or displayable characters (see Conversational Mode, Full Duplex and Conversational Mode, Half Duplex in preceding paragraphs).

CONTROL FUNCTION REPERTOIRE KEYS

The terminal keyboard will generate 32 control function codes commonly used with telecommunications input devices. Table 2-4 shows the keyboard operations required to generate these codes from the Display Terminal. Note that several often-used communication codes and edit function codes are available from their own separate key in addition to the CNTRL-plus-character key combination. This single key availability is for operator convenience with frequently used functions when operating in conversational mode; or for transmitting (STX), performing cursor control, or editing the displayed message when in block mode. Pressing the single editing type keys is the only way to edit a displayed message when in block mode.

Teletypewriter keyboards often require depression of CNTRL plus SHIFT plus a character key to generate control functions. These type keyboards are referred to as four-level keyboards. The Display Terminal uses a three-level keyboard. This allows generation of all 32 control functions without using the SHIFT key; however, pressing the SHIFT key in conjunction with the CNTRL key does not alter the functions shown in table 2-4.

Eleven of the control function codes provide editing of the display data. One additional code (bell) causes a sonic alert tone in the terminal. These codes are noted in table 2-4. The following pages in this section describe display response to these control functions for message editing and data entry cursor control. All CNTRL-plus-key inputs enter the assigned code for the particular control function. In block mode, the code enters the display memory at the cursor position and a character assigned to identify the control function (see table 2-5) appears on the view screen as a blinking character whenever the CNTRL key or EDIT key is depressed. This allows an operator to enter control functions within a message and identify their location by the blinking character. Conversational, full duplex mode, CNTRL-plus-key generated codes transmit immediately to remote equipment and no blinking character display occurs. Only if displayable characters (listed in table 2-3) or the 11 operation control function codes noted in table 2-4 are returned, will display change occur. In conversational mode, CNTRL-plus-key generated codes transmit to remote equipment and appear simultaneously on the display according to their assigned editing or cursor control function.

Space is provided at the end of these descriptions for notes concerning use of those remaining communications control functions which are capable of variable use depending on specific user's communications system programming.

CLEAR Key (or CNTRL + X When in Conversational Mode)

When the display receives the function code (030_8), it removes all displayed data from the screen. If the terminal is in scroll format mode, the cursor resets to the first character position of the last line. If the display is in page mode, the cursor resets to the first character position of the top line.

LINE CLEAR Key (or CNTRL + V When in Conversational Mode)

When the display receives the function code (026_8), it removes all displayed data from the cursor position to the end of the line only when the terminal is in page format mode. The cursor does not move and only the line with the cursor is affected. Scroll mode disables this function.

RETURN Key (or CNTRL + M When in Conversational Mode)

The RETURN function does not affect data. When the display receives the function code (015_8), the cursor resets to the first character position of the line it is in regardless of the format mode.

RESET Key (or CNTRL + Y When in Conversational Mode)

The RESET function does not affect displayed data. When the display receives this function code (013_8), and the terminal is in scroll format mode, the cursor resets to the first character position of the last line. If the machine is in page mode, the cursor resets to the first character position of the top line.

← (Backspace) Key (or CNTRL + H When in Conversational Mode)

When the display receives this function code (010_8), it moves the cursor back one character position without affecting displayed data. If the cursor is in the first character position of a line when the key is depressed, it automatically moves to the last character position in the preceding line. If the cursor is in the first character position of the top line, it moves to the last character position in the bottom line.

→ (Skip) Key (or CNTRL + U When in Conversational Mode)

When the display receives this function code (025_8), it advances the cursor one character position. If the cursor is in the last character position of any line (except the last line) when the skip function is enabled, the cursor automatically moves to the first character position of the next line. If the cursor is in the last character position of the bottom line and scroll mode is active, all data moves up one line position, the top line disappears from the viewing screen, and the cursor moves to the first character position in the new blank bottom line. When the cursor is in the last character position of the bottom line and page mode is active, the cursor moves to the first character position in the top line.

↑ (Up) Key (or CNTRL + Z When in Conversational Mode)

When the display receives the function code (032_8), it moves the cursor up one line; displayed data is not affected. If the cursor is in the top line when the key is pressed, the cursor moves to the same relative position in the bottom line.

↓ (Down) Key (or CNTRL + J When in Conversational Mode)

When the display receives the line feed function code (012_8), it moves the cursor to the same relative character position in the next line down. Displayed data is not affected unless the key is used when the cursor is in the bottom line and the display is in scroll mode. Then all data moves up one line, the top line disappears from view on the display screen, and the cursor returns to the first character position in the new last line. This provides a "carriage return" and "line feed" function. When the cursor is in the bottom line and page mode is active, the cursor moves to the same relative character position in the top line.

Start Inverse Video, CNTRL + N

See Inverse Video, this section.

End Inverse Video, CNTRL + O

See Inverse Video, this section.

Start of Text (CNTRL + B Only)

The start of text function marks the beginning of a message and is useful when multiple messages are composed. Pressing the CNTRL key in conjunction with the B key when operating the terminal in full or half duplex transmission mode transmits the start of text control function code (002_8) to the remote equipment. In full duplex conversational mode, if the remote equipment echoes this code, the terminal disregards the code. In half duplex conversational mode the display portion of the terminal ignores the code.

When the terminal is in block mode, pressing CNTRL and B keys enters the start of text control code at the cursor position. Whenever the CNTRL key is held depressed thereafter or the EDIT switch is active, this control code will appear on the view screen as a blinking "B". Multiple messages may be assembled prior to transmission when operating in block mode.

ETX Key (or CNTRL + C)

When the display receives the function code (003_8), it displays the end of text character (▲) at the cursor position. This function is useful to mark the end of text of multiple messages appearing on the view screen. The terminal recognizes and performs this function when entered from the keyboard, or when it arrives in a receive message, regardless of the duplex mode used.

End of Transmission (CNTRL + D Only)

Pressing CNTRL plus D keys when operating the terminal in full duplex transmission mode transmits the end of transmission (EOT) code (004_8) to the remote equipment. If the remote equipment echoes this code, the terminal disregards the code. In half duplex conversational mode, CNTRL plus D key entry transmits the EOT but the display ignores it.

When the terminal is in block mode, pressing CNTRL plus D keys enters the end of transmission control code at the cursor position. Whenever the CNTRL key is held depressed thereafter, or the EDIT switch is active, this control code will appear on the view screen as a blinking "D". This function allows an operator to end a block message transmission at some point before the end of the last display line. This is especially useful when an operator wishes to transmit only part of the data displayed on the view screen. A transmission (see STX key description) begun ahead of the EOT code location will end at the EOT code instead of at the end of the last display line.

STX Key

The STX key allows block message transmission from the terminal to remote parties when the terminal is operating in block mode. If the keyboard is not locked out due to a previous communication with remote equipment or with the optional local hardcopy printer, pressing the STX key causes the following:

- Keyboard will lock.
- Message transmission to remote equipment occurs from the cursor position through the first following end of transmission code or the end of the last display line, whichever comes first.

Any control functions (refer to table 2-5) contained in the message will be transmitted the same as with displayed characters. If a carriage return is transmitted, any spaces following it for the rest of that line will not be transmitted, but any other codes of more than 40_8 will transmit (such as 1, 2, 3, or A, B, C, codes of more than 40_8). When the transmission is completed, the cursor will be positioned one character space to the right of the EOT character, if present, or at the first character position of the first display line, if no EOT code is present.

Software-Dependent Spare Control Functions

Space is provided below for notes concerning use of the remaining separate key control functions (ESCAPE, FS, GS, RS, and US) and the CNTRL-plus-key control functions not described in the preceding text. These remaining functions (see table 2-4) are available for special use depending on the specific telecommunications system.

ESCAPE (or CNTRL + [ ) ____________

FS (or CNTRL + \ ) ____________

GS (or CNTRL +]) ____________

RS (or CNTRL + ∧) ____________

US (or CNTRL + _) ____________

Software-Dependent Spare Control Functions (Cont)

SPECIAL CONTROL KEYS

Three keys are referred to as special control keys; these are the BREAK, RUB OUT, and PRINT keys.

BREAK Key

Pressing this key when the terminal is in remote operating condition (LOCAL indicator/switch extinguished) causes the transmission line to go from a static mark condition to a space (break) condition for the duration of 300 milliseconds. This is a common telecommunications signal; however, it's use depends upon your individual communications system.

If a break condition should occur on the terminal Receive Data line for a period of ten character bit times or longer, two parity error characters will appear on the display screen.

Space is provided below for notes concerning use of this special function.

RUB OUT Key

When the terminal is in block mode, pressing this key displays the rub out character (▮) at the cursor position. When block mode is inactive, using this key transmits the 177_8 code.

The terminal logic circuits contain a rub out suppression strap option so that receiving the 177_8 code causes no terminal action. If the strap option is removed, 177_8 codes received will display the rub out character at the cursor position.

Space is provided below for notes concerning use of this special function.

PRINT Key

See the description in table 2-1 and "Printer Off-Line Mode," this section.

TRANSMIT OPERATION (STX)

To send a message from the Display Terminal, perform the following steps.

Full Duplex Conversational mode: Commonly used when communicating within a central processor-controlled communications system.

- Compose message using character, function, and cursor control keys. Keyboard entries should echo from processor and appear on display screen.
- Press CNTRL key in conjunction with the D key at end of message composition.

The message travels keyboard-entry-by-keyboard-entry to the receiving processor. The end of text control code signifies completion of communication to the processor.

Half duplex conversational mode: Same as full duplex mode except keyboard generated data appears on the display screen directly from the keyboard instead of depending on an "echo-back" from a central processor.

Block mode: This mode is to be used for block message transfers to a central processor or other receiving stations.

- Compose message using character, function, and cursor control keys.
- Position cursor to the first character of message intended for transmission, using cursor controls as necessary.

NOTE

Do not use CNTRL key when moving cursor or cursor control codes will enter in the displayed message rather than move the cursor.

- Press STX key. The cursor will rapidly increment to the end of the page. If the terminal is in page mode, the cursor will move to the first character position of the top display line. In scroll mode, the cursor will return to the beginning of the bottom display line.

The keyboard is electronically disabled during a transmit operation. The transmitted message begins at the cursor position and ends at the end of page. If partial transmission is desired, see STX/EOT description.

PARTIAL MESSAGE TRANSMISSION (STX/EOT)

To transmit only a part of the data displayed on the screen, perform the following steps.

- Place the terminal in block mode.
- Position the cursor at the first character position to the right of last character of data to be sent.
- Press CNTRL and D keys simultaneously to enter an end of transmission code. The end of transmission character (blinking 'D'), see table 2-5, displays at the cursor position while the CNTRL key is depressed and is observable afterward whenever CNTRL or EDIT is pressed.
- Position the cursor to the first character position of the message to be transmitted.
- Press the STX key. The cursor will advance rapidly to one character position beyond the EOT location.

This operation is basically the same as for a full display message transmission (see Transmit Operation, preceding paragraphs). The difference is that the end of transmission function allows an operator to enter a message end point anywhere within the full display. When the message is transmitted, the message begins at the cursor and ends at the position containing the end of transmission code. For full screen transmissions, an end of transmission is implied at the last character position of the bottom display line.

OPTIONS

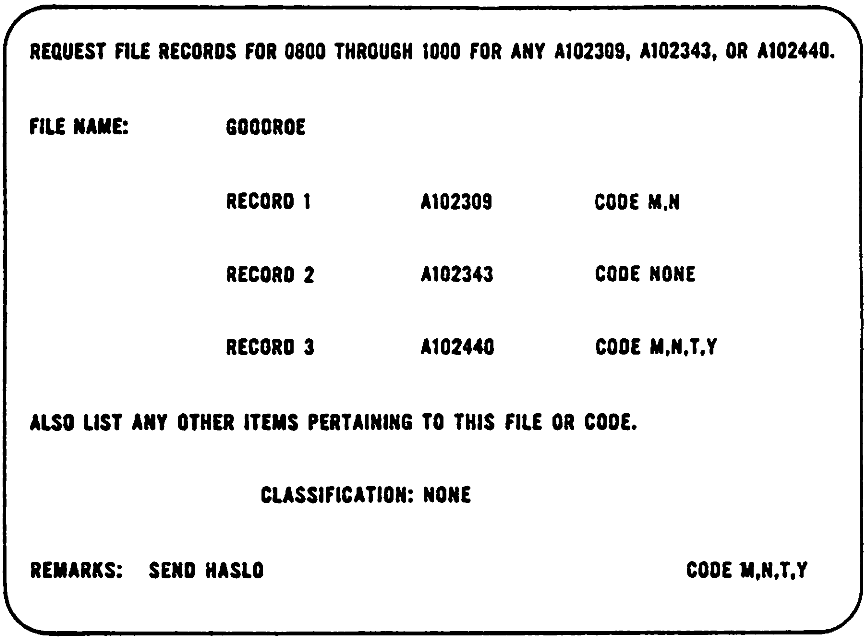
This portion of the manual describes options that may be used with the terminal. If the equipment does not use an option, disregard the description.

The terminal may use the following options.

- Option 1 — 16-line x 80-character display format (internal)
- Option 2 — hardcopy printer (external)

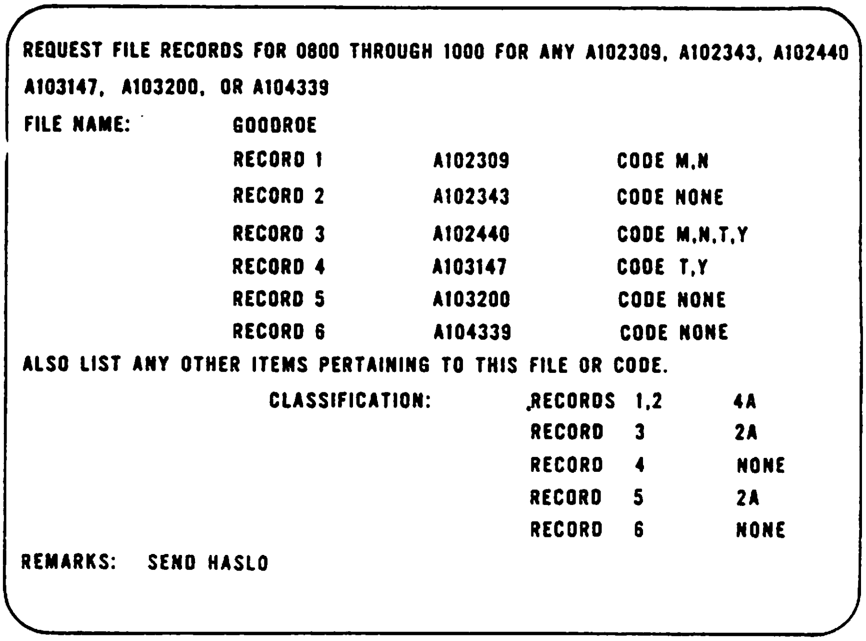
16 x 80 DISPLAY FORMAT OPTION

The terminal is designed to accept a character memory expansion of 640 additional characters, thus enabling 16 lines of 80 characters on the video display as compared with the basic version with 8 lines of 80 characters, figure 2-5. This expansion is a "plug-in" printed circuit card consisting of a second character memory card (expanded memory kit BT1A9-A). The two character memory cards are fully interchangeable. This expansion is easily made as an on-site change. It may be ordered by a customer after receiving the basic terminal.



```
REQUEST FILE RECORDS FOR 0800 THROUGH 1000 FOR ANY A102309, A102343, OR A102440.

FILE NAME:              GOODROE

                        RECORD 1        A102309         CODE M,N

                        RECORD 2        A102343         CODE NONE

                        RECORD 3        A102440         CODE M,N,T,Y

ALSO LIST ANY OTHER ITEMS PERTAINING TO THIS FILE OR CODE.

                             CLASSIFICATION: NONE

REMARKS:   SEND HASLO                                           CODE M,N,T,Y
```

STANDARD 8 X 80 DISPLAY



```
REQUEST FILE RECORDS FOR 0800 THROUGH 1000 FOR ANY A102309, A102343, A102440
A103147, A103200, OR A104339
FILE NAME:              GOODROE
                        RECORD 1        A102309         CODE M,N
                        RECORD 2        A102343         CODE NONE
                        RECORD 3        A102440         CODE M,N,T,Y
                        RECORD 4        A103147         CODE T,Y
                        RECORD 5        A103200         CODE NONE
                        RECORD 6        A104339         CODE NONE
ALSO LIST ANY OTHER ITEMS PERTAINING TO THIS FILE OR CODE.
                             CLASSIFICATION:       RECORDS 1,2      4A
                                                   RECORD  3        2A
                                                   RECORD  4        NONE
                                                   RECORD  5        2A
                                                   RECORD  6        NONE
REMARKS:   SEND HASLO
```

OPTIONAL 16 X 80 DISPLAY

Figure 2-5. Character Memory Expansion

PRINTER OPTION

The optional hardcopy printer may operate either on line or off line with the Display Terminal.

Printer On-Line Mode

The common use of an on-line printer with the terminal is to provide an automatic, permanent copy of incoming messages. The operator must observe the following items when placing the terminal on line with an associated printer.

1) Check that PRTR BSY indicator is extinguished.

2) Check that baud rate is not set over 300 baud.

3) Press PRINTER REQUEST switch (this switch should illuminate and the PRTR BSY indicator should come on).

When the printer is on line with the terminal, all received or transmitted messages will transmit to the printer.

Printer Off-Line Mode

Normally the printer should be off line (PRINTER REQUEST indicator extinguished) when the operator is composing messages with the terminal in block mode. This, in effect, allows the operator to make a "rough draft" of messages and perform any necessary corrections without the printer recording each character as it is entered and/or changed within a message. When a message is complete, a printed copy may be made by following the steps below.

1) Check that PRTR BSY indicator is extinguished.

2) Press PRINT Key. Message transfer will start at the cursor position. The PRTR ACT indicator will illuminate during transfer of the displayed message. During this message transfer, the keyboard is locked out to ensure correct hardcopy of the displayed message; however, an incoming message from external equipment (eg, central processor) will enter the terminal regardless of the print operation.

STRAP OPTIONS

Located on two circuit boards within the terminal display logic module (see figure 2-6) are three jumpers referred to as strap options. These jumpers insert in press-fit, hand adjustable, sockets in the circuit boards.

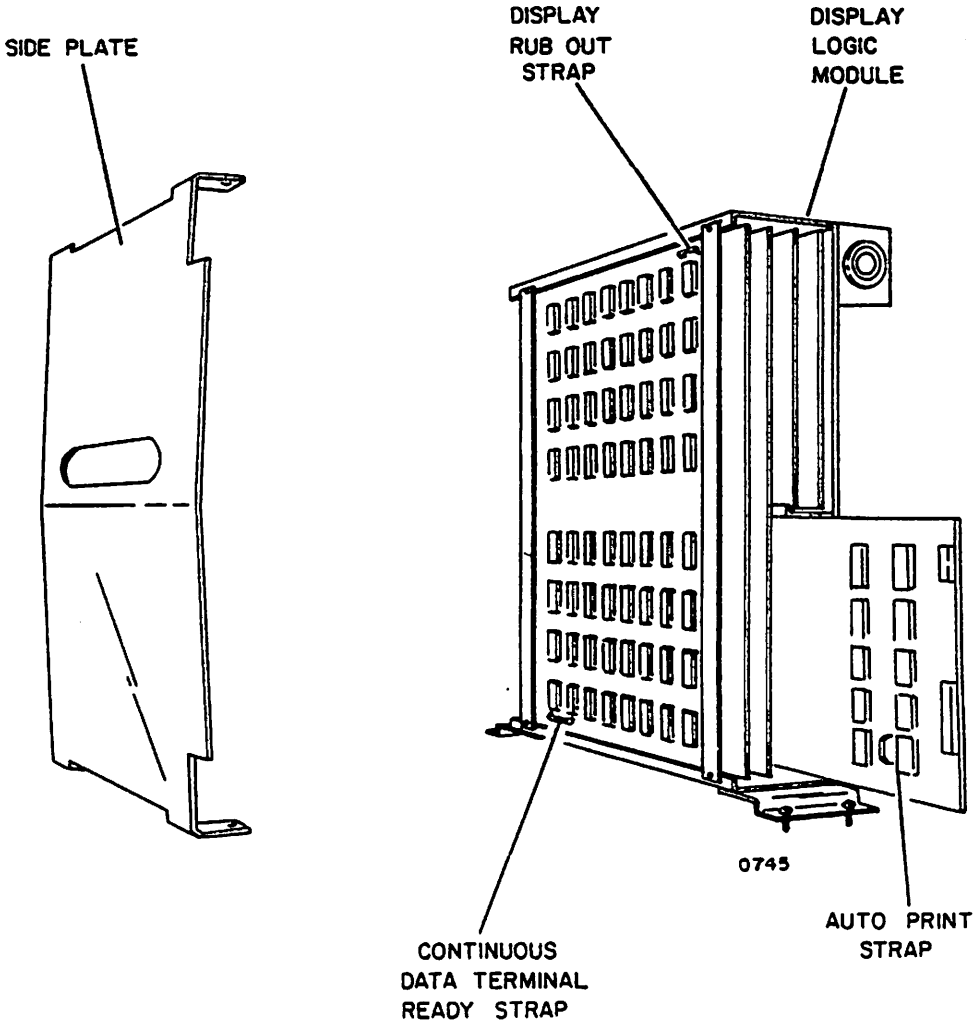


Figure 2-6. Strap Options

RUB OUT OPTION

This jumper allows a choice of not displaying or displaying a character for received rub out codes (177_8). With the jumper in place, no display occurs for received 177_8 codes; however, rub out (▮) does not display upon RUB OUT key depression if the terminal is in block mode. With the jumper out, a rub out character (▮) displays whenever a 177_8 code is received. The basic unit has the jumper in place.

CONTINUOUS DTR OPTION

If this jumper is in place, the terminal issues a continuous data terminal ready (DTR) signal to the modem interface whenever POWER is on (indicator illuminated). With the jumper out, the terminal issues a DTR signal only when the LOCAL switch is in the remote operating mode (LOCAL indicator extinguished). In local mode, the terminal is not ready to transmit, so a DTR is not issued. The basic unit does not have the jumper.

AUTO PRINT OPTION

With this jumper present, receipt of a print code (021_8) causes the terminal to send the entire display to the printer channel if the terminal is not on line with the printer (see Printer On-Line Mode, this section). When this jumper is absent, the print code is ignored. The basic unit does not have the jumper.

PROGRAMMING

3

This section supplies programming information for the Display Terminal. Figure 3-1 shows a terminal's relationship within a telecommunications system. For information regarding the hardware involved, refer to Section 1, General Description and Section 2, Operation. Interface characteristics, word format, message formats, displayable character codes, display station control codes, telecommunication control codes, message responses, station assignments, and memory size are described in this section.

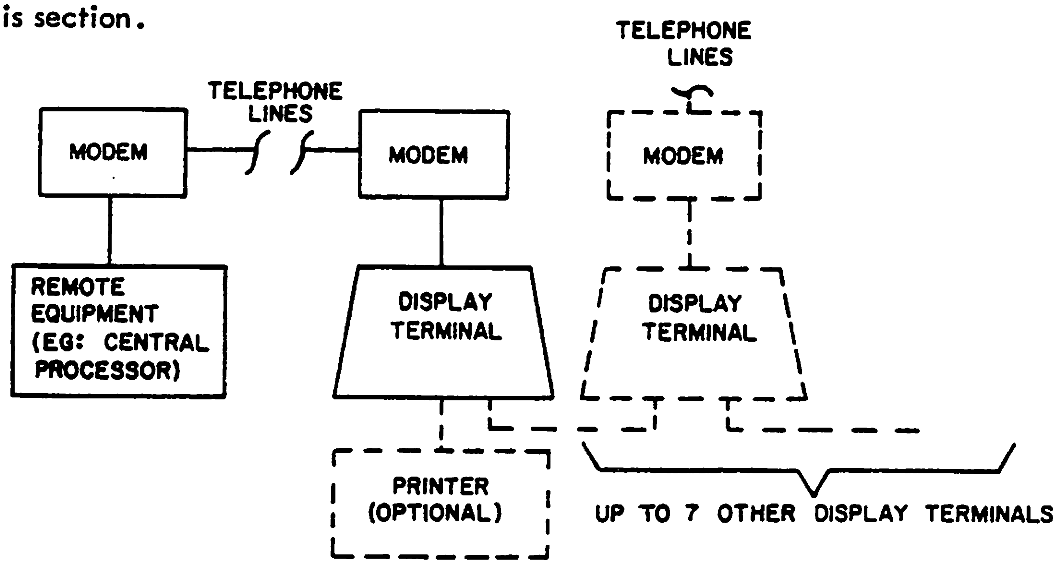


Figure 3-1. Typical Terminal Telecommunications System

INTERFACE CHARACTERISTICS

Telecommunications with the Display Terminal occur between a remote communications device and a single-station Display Terminal (see figure 3-1). The terminal is designed for asynchronous telecommunications operation via modems (modulator/demodulators) conforming to EIA Standard RS-232-C and CCITT recommendation V.24. This means the interface is compatible with AT&T 103 series data sets (or equivalent) with data transfer rates of 75, 110, 150, 200, 300, 600, 1200, 1800, 2400, 4800 and 9600 baud. Communication is send and receive, 2-wire mode, serial, via time-shared or standard telephone lines. Each terminal operates as a single station in that it communicates directly to/from it's own modem which accesses the telephone lines.

The remote device with which telecommunication occurs may be a communications oriented central processor which both sends and receives messages, or it may be telecommunications send/receive stations.

WORD FORMAT

Communications messages between the terminal and central processor are word serial transmitted in a bit serial manner. Each communications word is eight bits including one parity bit as shown in figure 3-2. A bit is transmitted or received as either a 1 or a 0. Bit 2^0 is received or transmitted first. Bits 2^0 through 2^6 enable a total of 128 different codes compatible with the ASCII X3.4-1968 code set. Bit 2 of each word represents parity for bits 2^0 through 2^6.

2^7 PARITY	2^6	2^5	2^4	2^3	2^2	2^1	2^0

Figure 3-2. Word Format

A manual switch setting allows odd, even, or no parity selection (see PARITY Switch, Section 2). The transmitting circuits count the number of 1's in bits 2^0 through 2^6 of a generated word. For odd parity setting (when the number of data bit 1's is even), a 1 is sent for bit 2^7 making the total number of 1's odd and if the number is odd, a 0 is sent for bit 2^7 leaving the total number of 1's odd. For even bit 2^7 leaving the total number of 1's even and if the number is odd, a 1 is sent for bit 2^7 making the total number of 1's even. With no parity setting, parity is disregarded. The receiving circuits use the parity bit to determine correct receipt of the word.

Upon receipt of the word, the receiving circuits count the number of 1's in all bit positions. When odd parity is set, the receiving circuits accept the word when the number of 1's is odd and generates a parity error character (▮) for display if the number of 1's is even. When even parity is set, the receiving circuits accept the word when the number of 1's is even and generates a parity error character for display if the number of 1's is odd. Since generating and checking the parity bit is not a programming function but is controlled by the transmitting and receiving circuits, octal codes shown in this section do not include the parity bit.

MESSAGE FORMATS

The terminal communicates with remote equipment using control sequences as defined in following paragraphs. Messages are received and sent by the terminal on an asynchronous data-word-by-data-word basis.

A group of data words received or sent comprises a message. The format for receiving data words in a message differs from that for sending message words. Table 3-1 shows the message formats for receive data and send data.

TABLE 3-1. RECEIVE AND SEND MESSAGE FORMATS

	RECEIVE DATA WORD FROM CPU MODEM		SEND DATA WORD TO CPU MODEM
	Stop (logical 1)*		Stop (logical 1)*
	Start (logical 0)		Stop
	Word Bit 0		Start (logical 0)
	1		Word Bit 0
One Word	2	One Word	1
	3		2
	4		3
	5		4
	Word Bit 6		5
	Parity		Word Bit 6
	Stop (logical 1)*		Parity
	Start (logical 0)		Stop (logical 1)*
	Word Bit 0		Stop
	1		Start (logical 0)
	2		Word Bit 0
	.		1
	.		2
	Word Bit .		Word Bit .

* Receive data requires at least one stop bit between data words and transmitted data requires at least two stop bits between data words.

TYPES OF MESSAGES

The Display Terminal does not use control sequence messages such as poll, alert, or acknowledge; therefore, all messages, either received or transmitted, are considered as data messages and are merely a series of data words. Each data word is received or transmitted as shown in table 3-1.

Transmitted messages in conversational communications modes will leave the terminal data-word-by-data-word in a bit-serial fashion as each keyboard input is made by the operator. Transmitted messages in block mode will leave the terminal data-word-by-data-word in a series of data words which comprise the displayed message being transmitted by the operator. The transfer rate depends on the terminal BAUD RATE switch setting.

A transmitted message in block mode may contain control codes such as start of text, start of heading, FS, US, etc. and each message will have an end of text control code. These control codes are considered part of the data message and may be used by the receiving device to identify beginning and ending of messages and to perform formatting operations.

Receive messages take precedence in the terminal. Received messages will enter the terminal at whatever rate the BAUD RATE switch is set. The BAUD RATE switch must be set to match rates used in the communications system.

CODE REPERTOIRE

The code repertoire is compatible with ASCII X3.4-1968. For programming purposes these codes are divided into three basic groups: displayable character codes, terminal control codes, and telecommunication control codes. The following paragraphs describe each group.

DISPLAYABLE CHARACTER CODES

Table 3-2 lists the displayable character codes available in display with this terminal. Two character sets are available: 96 and 64. The 96-character set includes all characters shown in the table. A 64-character set may be used by changing the character set switch on the connector panel. Characters available with this set are indicated in table 3-2. The full 96-character set may be received from a remote device and displayed independent of the character set in use.

TABLE 3-2. DISPLAYABLE CHARACTER REPERTOIRE

OCTAL CODE	CHARACTER	OCTAL CODE	CHARACTER
040	(space)	123	S
041	! (exclamation point)	124	T
042	" (quotation mark)	125	U
043	# (number or pounds)	126	V
044	$ (dollar sign)	127	W
045	% (percent)	130	X
046	& (ampersand)	131	Y
047	' (apostrophe)	132	Z
050	((left parenthesis)	133	[(left bracket)
051	) (right parenthesis)	134	\ (reverse slant)
052	* (asterisk)	135	] (right bracket)
053	+ (plus)	136	^ (circumflex)
054	, (comma)	137	_ (underline)
055	- (hyphen or minus)	140	` (left single quote mark)
056	. (period)	141	a
057	/ (slant)	142	b
060	0	143	c
061	1	144	d CHARACTERS NOT AVAILABLE FROM KEYBOARD WHEN 96/64 SWITCH IS SET AT 64. THESE ARE REPLACED BY CHARACTER CODE 40_8 LESS. (LEFT BRACE, 173_8, REPLACED BY LEFT BRACKET 133_8.)
062	2	145	e
063	3	146	f
064	4	147	g
065	5	150	h
066	6	151	i
067	7	152	j
070	8	153	k
071	9	154	l
072	: (colon)	155	m
073	; (semicolon)	156	n
074	< (less than)	157	o
075	= (equals)	160	p
076	> (greater than)	161	q
077	? (question mark)	162	r
100	@ (commercial at)	163	s
101	A	164	t
102	B	165	u
103	C	166	v
104	D	167	w
105	E	170	x
106	F	171	y
107	G	172	z
110	H	173	{ (left brace)
111	I	174	| (vertical line)
112	J	175	} (right brace)
113	K	176	~ (equivalent or similar)
114	L	177	▮ (rub out or parity error)
115	M		
116	N		FUNCTIONS
117	O		
120	P	003	▲ (ETX)
121	Q	016	❮ (begin inverse video)
122	R	017	❯ (end inverse video)

NOTE: Control functions are available in addition to the displayable characters shown above. In block mode, these functions are displayable as blinking characters when the CNTRL key or EDIT key is pressed, see Section 2.

TERMINAL CONTROL CODES

Table 3-3 defines the terminal control code repertoire. Each of these codes will cause a terminal operation when received in a message, entered by the operator which the keyboard, or when placed within messages for remote stations. See Control Function Repertoire Keys, Section 2 for complete descriptions of these terminal control codes.

TABLE 3-3. TERMINAL CONTROL CODES

NAME	7-BIT OCTAL TRANSLATION	PURPOSE
NUL	000	No-op, provides timing per telecommunication requirements.
ETX	003	Enters the ETX character (▲) at the cursor position in display memory.
BS (←)	010	Moves cursor to the preceding character position.
LF (↓)	012	Advances cursor one line down, same character position.
RETURN	015	Resets cursor to the beginning of the line.
START INVERSE VIDEO	016	Enters start inverse video character (❮) at the cursor position in the display memory.
END INVERSE VIDEO	017	Enters end inverse video character (❯) at the cursor position in the display memory.
DC1 (Print)	021	Sends entire page of currently displayed data to the printer if the auto print option is in place (see Options, Section 2).
SKIP (→)	025	Advances cursor one character position.
LINE CLEAR	026	Enters spaces from the cursor position to the end of the line in display memory.
CLEAR	030	Enters spaces in entire display memory and resets cursor.
RESET	031	Moves cursor to the first data entry position in display. Page mode: first character, top line. Scroll mode: first character, bottom line.
CURSOR UP (↑)	032	Moves cursor to preceding display line, same character position.
BEL	007	When received, causes sonic tone to alert operator of a communications condition, depending on the system.

TELECOMMUNICATIONS CONTROL CODES

Table 3-4 shows the telecommunications control codes available from the Display Terminal keyboard. Operator use of these codes is dependent on the type of communications system using this terminal and also is dependent on the type of remote devices being used (eg, central processor, receive-only teletypewriter, etc). Such information is unique to each terminal user and therefore is not included in this text.

TABLE 3-4. TELECOMMUNICATIONS CONTROL CODES (ASCII X3.4-1968)

MNEMONIC	OCTAL CODE	ASCII CONTROL FUNCTION
NUL	000	No-op, provides timing per telecommunications requirements
SOH	001	Start of heading
STX	002	Start of text
ETX	003	End of text
EOT	004	End of transmission
ENQ	005	Enquiry
ACK	006	Acknowledge
BEL	007	Alert
HT	011	Horizontal tab
VT	013	Vertical tab
FF	014	Form feed
DLE	020	Data link escape
DC1	021	Device control 1*
DC2	022	Device control 2
DC3	023	Device control 3
DC4	024	Device control 4
EBT	027	End of transmission block
ESC	033	Escape
FS	034	File separator
GS	035	Group separator
RS	036	Record separator
US	037	Unit separator

* Causes a print operation if the auto print option is included (see Options, Section 2).

MESSAGE RESPONSES

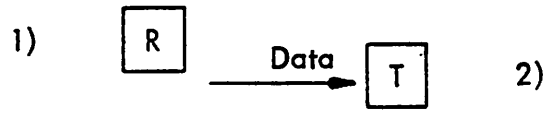
All terminal message transmissions to remote equipment are at the discretion of the terminal operator. Other telecommunication station operators or a telecommunications central processor may send a message to the terminal requesting a response. The operator, having read the message request, may reply with either an alphanumeric character message or an assigned control function response.

Remote party responses from operator-controlled telecommunications stations are at the discretion of the operator of that station.

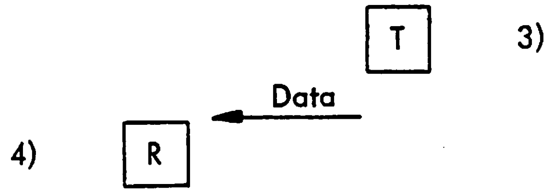
If a terminal operator is communicating with a telecommunications central processor and requests information which that processor can supply from its own capability, the terminal will receive a response of either character data, a terminal control code, or a message depending on the program being used by the central processor.

SEQUENCE OF REMOTE PARTY/TERMINAL MESSAGES

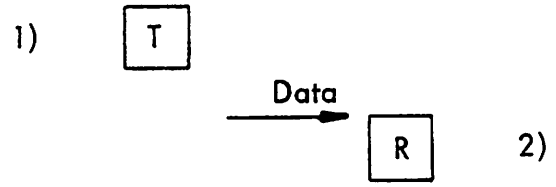
Remote party (R) composes and sends message to terminal (T) requesting information.



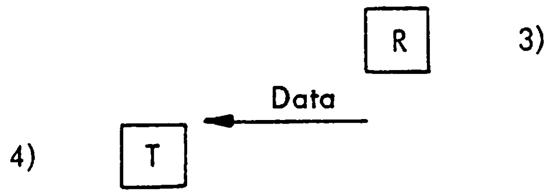
Terminal operator composes and transmits response.



Terminal operator composes and transmits message requesting information.

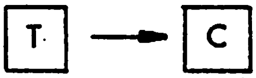


Remote operator composes and sends response.



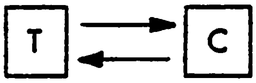
SEQUENCE OF PROCESSOR/TERMINAL MESSAGES

Block Mode: Terminal operator composes and transmits message requesting information from the computer (C).



Computer interprets message and transmits response message.

Full Duplex, Conversational Mode: Terminal operator composes and transmits a message requesting information from the computer.



Computer responds with data according to programming. This is a typical character-by-character data path when the terminal is operating in full duplex conversational mode with a central processor.

STATION ASSIGNMENTS AND MEMORY SIZES

As shown in figure 3-1, the Display terminal is designed to communicate directly with remote equipment via an AT&T 103 series modem (or equivalent). Each terminal utilizes its own modem and operates as a single-station communications device. In a dial-up arrangement, the only station assignment associated with a terminal is a telephone number assigned to the associated telephone line/terminal modem.

The terminal basic read/write refresh memory accepts message data of 8 lines of 80 characters each. With the expanded memory kit option, the terminal accepts 16 lines of 80 characters. Therefore, the limit for any message received by or transmitted in block mode from a terminal is either 640 or 1280 characters (depending on the option). Only storable (displayable) codes (see table 3-2) count toward filling memory during a receive message. Nonstorable terminal control codes (eg, bell, clear, etc.) may be used in a message from the central processor in addition to the 640 or 1280 storable codes, without overflowing memory.

Any message to the terminal larger then the capacity of the terminal memory must be transferred in blocks. A long message divided into two or more blocks may require terminal operations between blocks (eg, a print operation or operator response message). Communications system programming and operating procedures must accommodate multiple operations required and the time required for the total message transfer.

Of course, any message originating at a terminal is limited to the 8-line, 80-character or 16-line, 80-character size of the display memory. The terminal operator must be aware of message size limitations (if any) of remote receiving devices and compose messages intended for transmission accordingly.

NOTE

When the terminal is operating in scroll mode (PAGE indicator extinguished), received messages or messages composed at the terminal should not use the last character position of the bottom display line (8th line in basic machine or 16th line with expanded memory) or the scroll operation will occur causing loss of the top display line.

NOTES

Since the Display Terminal is designed with capability for varied telecommunications applications, operations in addition to those described in this section may apply (eg, specific use of various control function keys to gain access to a central processor's files, specific remote teletypewriter call procedures, etc,). The following space is provided for user notes regarding any additional programming requirements.